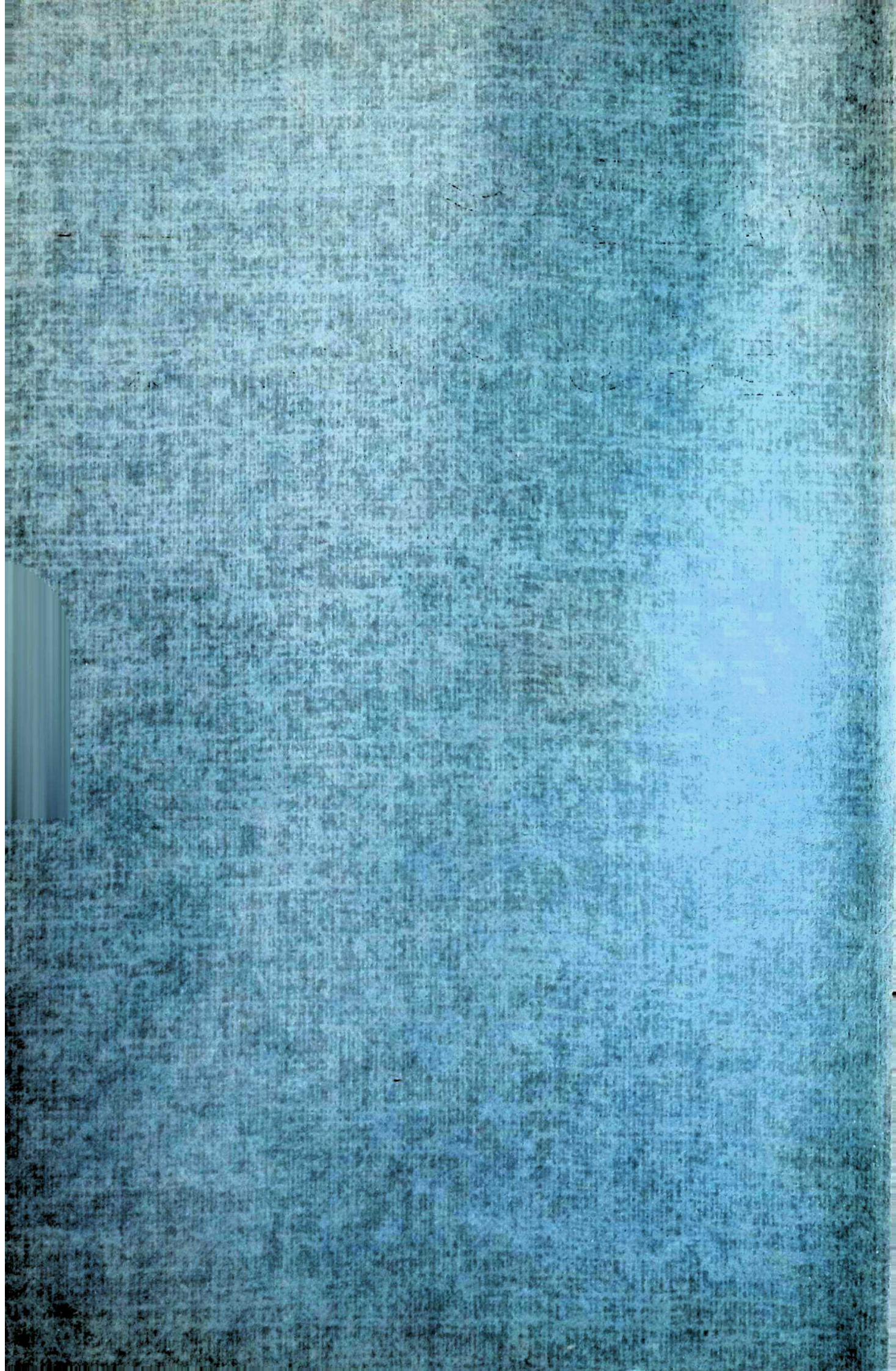


WATER-POWER EQUIPMENT

BULLETIN NO. 100

FITZ WATER WHEEL CO.
HANOVER, PENNA., U. S. A.



BULLETIN NO. 100

WATER POWER



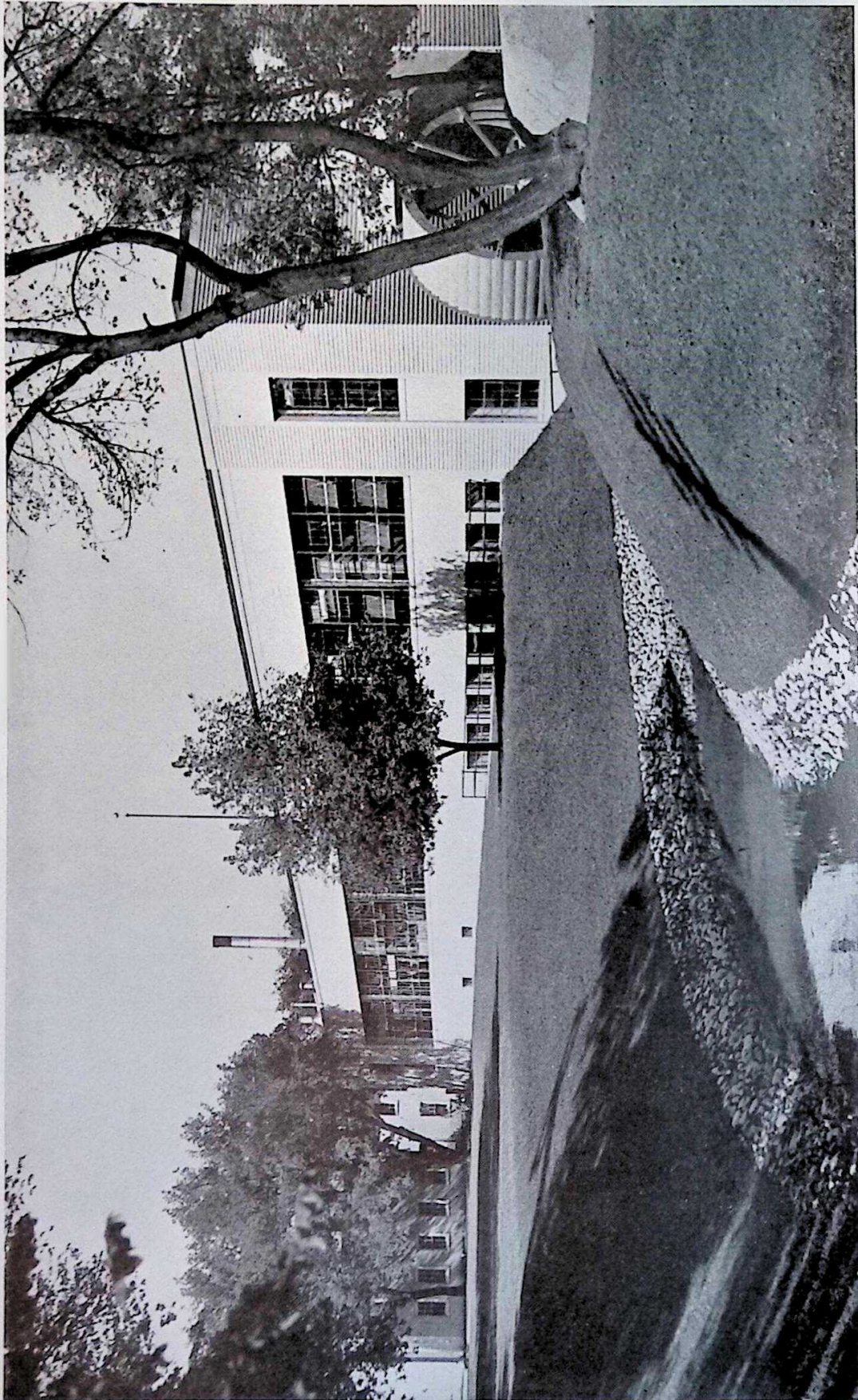
EQUIPMENT

MANUFACTURED BY

FITZ WATER WHEEL CO.
HANOVER, PENNA., U. S. A.

ESTABLISHED 1840

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18 ft. diameter by 8 ft. face Fitz Overshoot Water Wheel driving A. C. Generator at Ford Motor Company's new valve factory at Northville, Michigan. A Fitz Automatic Water Wheel Governor regulates the power and speed.

WATER POWER

The owner of a water power site is fortunate in having available the cheapest and best source of power the world has ever known. A water wheel uses no fuel, requires no attendant, and costs nothing to run. Its convenient and reliable service is not affected by strikes or transportation difficulties. It outlasts any other kind of machinery and requires fewer repairs.

A good water power site is a most valuable asset, but a large part of its advantages can be lost by using an old style inefficient turbine, or even a modern one of a type that is not suitable for the specific conditions existing in that location. In developing a new site, or in improving an old one, it is extremely important to instal a water wheel of the type and size that will obtain the most efficient results from the water and fall available in that location. No two water power sites are exactly alike, and a wheel that will do good work in one location may prove very unsatisfactory in another place where conditions are different.

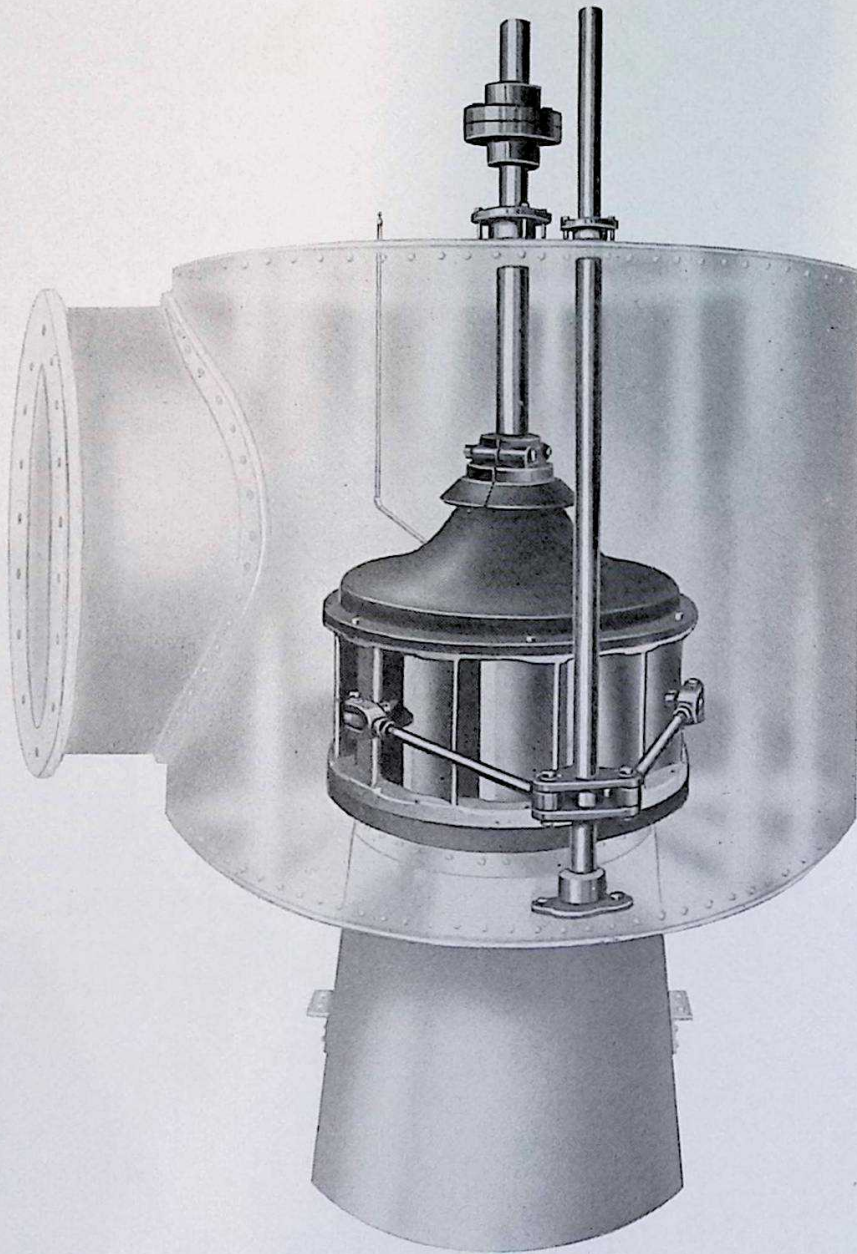
Fitz Water Wheels are designed to meet the wide variety of conditions that are found in the small water power field. We cover that field in a far more thoro manner than is attempted by any other water wheel builder, as we manufacture three complete and distinct lines of turbine water wheels, besides overshoot wheels, undershoot wheels, and impulse wheels.

Each one of our designs serves a range of conditions for which nothing else could be as good. From our wide variety of sizes and types we can furnish just exactly the right water wheel for any worth while small water power development.

Established in 1840, by Samuel Fitz, this firm has been building water wheels continuously for more than a century. The knowledge and experience accumulated by our organization over that long period, is at the service of our customers. We want them to utilize that service and we are always glad to submit individual recommendations for each installation, upon receipt of the information requested in our data blank.

When desired, we can send an experienced engineer, at a very reasonable charge, to make a personal report on a prospective water power development. Quite frequently we have been able to offer some very useful advice and suggestions thru this service.

The Fitz-Hanover Turbine



For High Efficiency.
Long Life.
Smooth, Steady Power.
Freedom from choking.
Easy and reliable regulation.
One-piece gate.
No spider or other obstruction beneath runner.
A well-built modern turbine, Ideal for Hydro-Electric Service.

A High-Class Modern Turbine with Many Distinctive Features

The Fitz-Hanover Turbine is the outcome of over a hundred years of experience in designing and building water wheels. It is eminently well suited for the moderate sized plant whose problems and conditions we have studied in the thousands of installations that we have made.

Turbines for small and medium sized plants must be economical of water. They must be relatively more rugged and more durable than in large plants where skilled labor is available for adjustments and replacements. They must be free from constant liability to broken gates. They should not require frequent realignment or attention. They must stand severe use in dirty water, also abuse and neglect. There are many Fitz Turbines in use today, that have seen more than forty years of service.

The Fitz-Hanover Turbine was designed with all of these requirements in mind. The outside curb is unusually heavy and is cast in one piece, of semi-steel. The register, or gate, is made in one piece, ten times as strong as the ordinary wicket or flutter gate. It is cast of semi-steel and its chutes are beveled to hydraulically correct angles. Among the thousands of turbines equipped with our type of gate, gate breakage is almost unknown. In addition, our gate moves the easiest of any. This is an extremely convenient feature in hand-regulated turbines, and is almost invaluable when automatic control is required.

The Fitz-Hanover Runner is hydraulically correct in design. Its form is based on many years of testing in a research laboratory and also on Hol-yoke tests. The vanes are of high-grade heat-treated steel, forged hot, to exact shape, over heavy dies, and then accurately set up to gauges. The band and hub are cast on of semi-steel. The runner is then machined to exact size and accurately balanced.

There is no spider below the Fitz-Hanover Runner. The runner is of the suspended type, like those used in the latest and largest hydro-electric plants now under construction. The elimination of the spider and the bottom thrust bearing permits the water to discharge entirely free.

The thrust bearing is water cooled by internal grooves and sufficient pressure is generated by centrifugal force, to keep these grooves open and to make the bearing self-cleaning. This is of great value in muddy water. The thrust bearing is carried on top of the turbine cover, just above the journal bearing, making it easy of access without having to dismantle the turbine, as is necessary in other turbines.

The vertical guide bearing mounted in the cover plate of the turbine is lined with a patented water-lubricated Micarta sleeve which requires no other lubrication under ordinary conditions. This sleeve is pressed into a long heavy hub that is cast integral with the cover itself. The hub is bored and faced at the same setting in which the turning and other machine work is done on the cover, thus ensuring perfect alignment. For use in extremely dirty or gritty water the long sleeve-bearing may be grease-sealed at both ends and lubricated regularly by an alemite gun from a convenient point outside the case or penstock. This special type of Micarta for journal bear-

ings is famous for its long life and freedom from friction, but if the bearing should eventually require renewal, a new sleeve can be slipped in place at small expense.

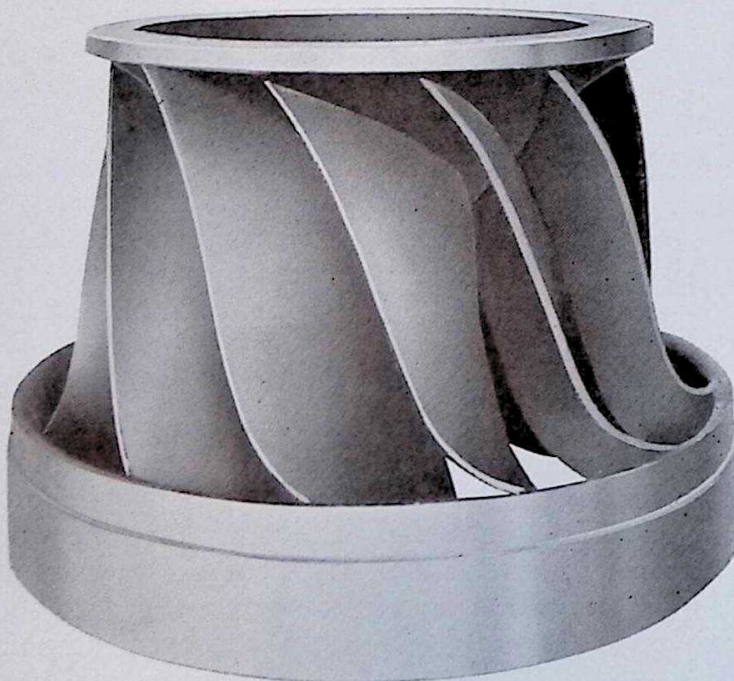
Our rock-shaft gate operating mechanism is a sturdy and simple device that grasps the gate on both sides at the same time, just as naturally as you would use your two hands for a similar service. There is no lost motion and no fluttering back and forth. No other gate mechanism on the market is so well suited for automatic control nor involves so little wear on an automatic governor.

A very unusual feature of the Fitz-Hanover Turbine is its ability to run under sub-normal heads with a much smaller loss of power than would occur with other turbines. The same new advance in hydraulic design, enables our wheel to maintain the same speed (but of course with reduced power) even when the head is greatly decreased by unusual circumstances. The Fitz-Hanover Turbine can hold its normal or synchronous speed at any lower head, down to within 50% of the normal head under which the wheel was installed.

This really remarkable performance is due to the design of our runner. It is accomplished by means of a leading spiral twist in the direction of absolute discharge, and it has a very helpful effect on the efficiency of the turbine when the wheel is run under "off-speed" conditions. This is an exclusive feature of the Fitz-Hanover Turbine and its value can hardly be overestimated for electric light plants or for other installations where a constant regular speed is necessary.

All Fitz-Hanover Turbines are equipped with draft tubes and should be set a reasonable distance above the normal low water surface of the water in the tail race. Therefore they should not be used under such extremely low heads as our Fitz-Burnham Turbines described later on in this booklet.

Runner of Fitz-Hanover Turbine



Hydraulically balanced design.

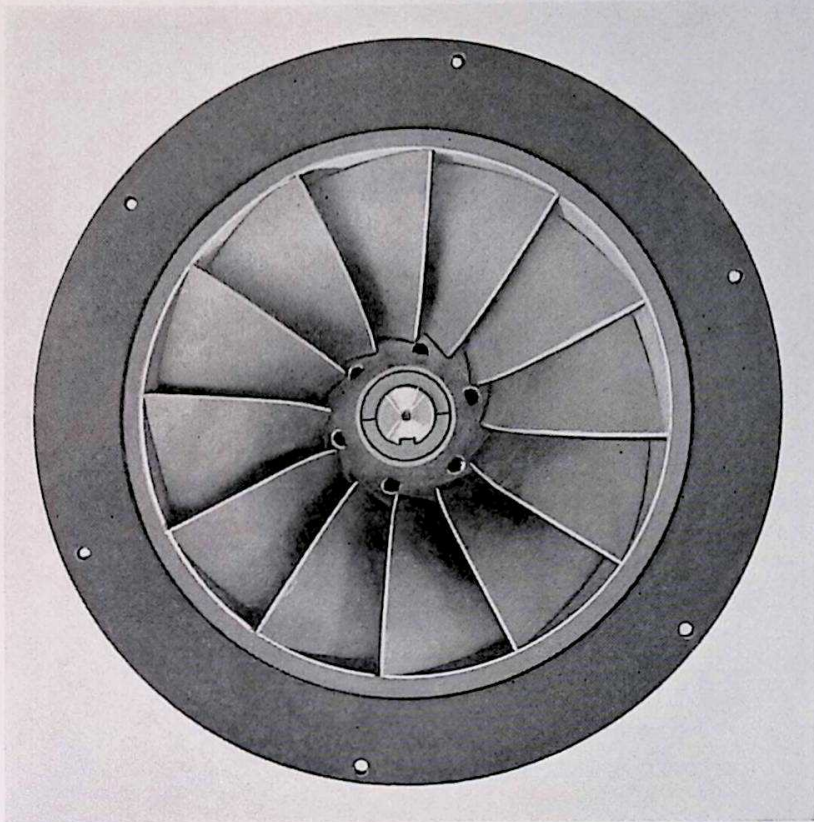
Easily governed.

Remarkably free from clogging with leaves or sticks or eels. Compare its stream-lined passage ways with the paths that the water must take in other high speed runners.

No buckets projecting below the bottom runner band to cause breakage.

Absolutely free discharge. No spider or other obstruction below runner.

Bottom View of Fitz-Hanover Turbine



The discharge from a Fitz-Hanover Turbine is entirely unobstructed.

There is no bottom step bearing to grind out in sandy water, and no cross piece or spider to catch trash.

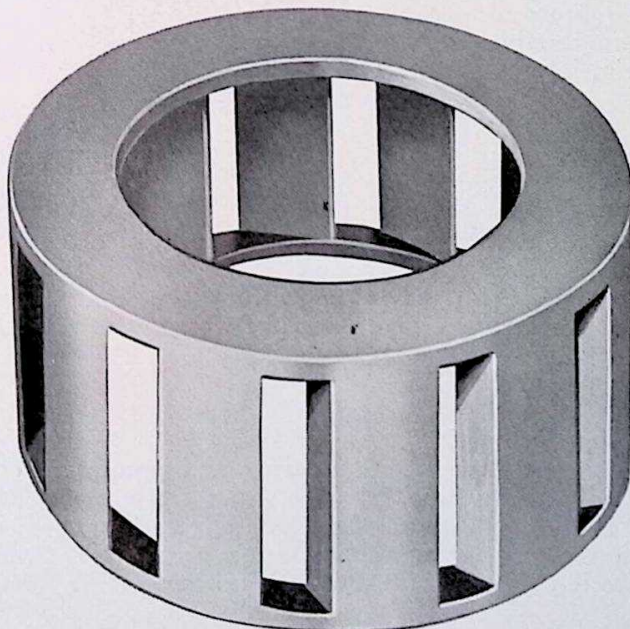
Instead of being located in the usual inaccessible position underneath the runner, the lignum vitæ thrust bearing is mounted on top of the cover plate where it is easy to get at.

All Fitz-Hanover Turbine runners revolve right

hand. Viewed from the top, the runner turns in the same direction as the hands of a watch.

The diameter of a Fitz-Hanover Turbine is measured at the large end of the runner, the logical and most convenient place. Nearly all other makes of turbines are measured at the smallest part of the runner, which is somewhat misleading. Comparisons of capacity should be based on the volume of water used by a turbine, rather than on its nominal size. For in-

stance, 24" turbines of some types may easily use more water than a 36" Fitz turbine under the same head.

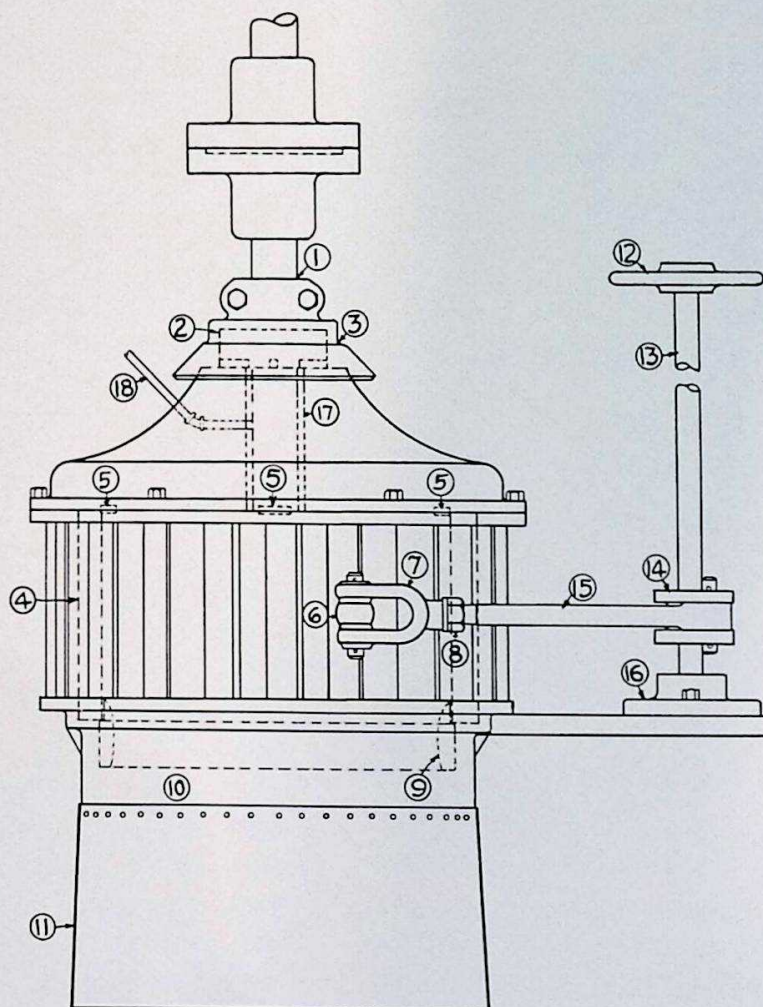


Fitz One-piece Regulating Gate

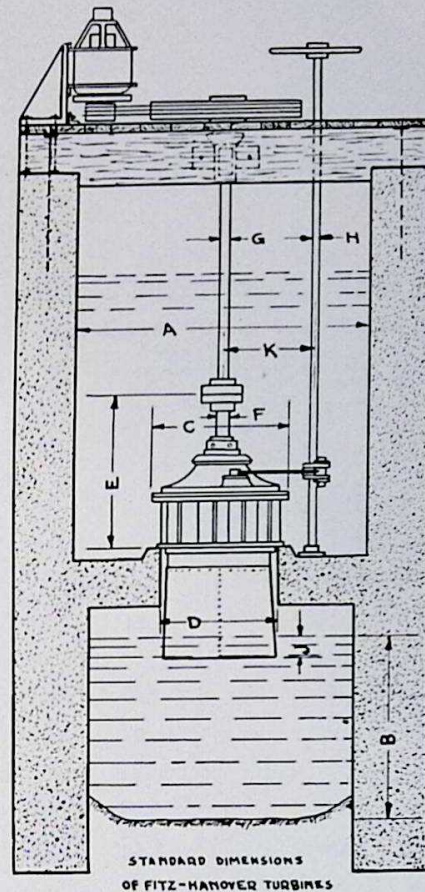
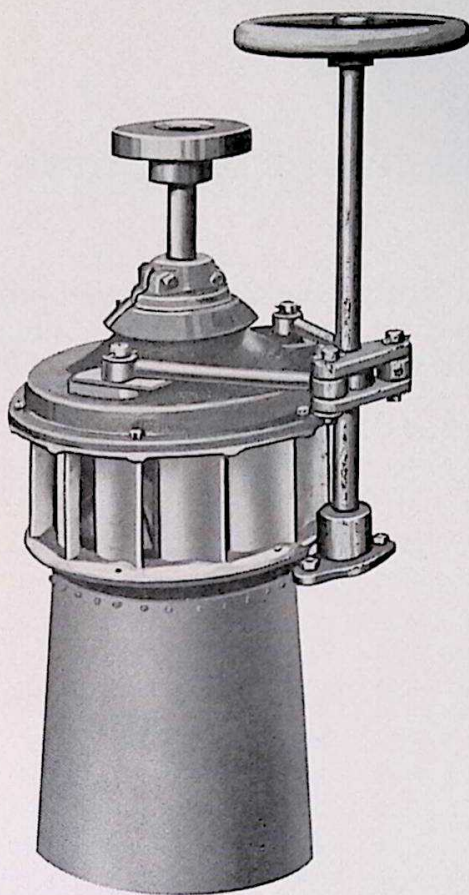
Cast in one solid piece with none of the numerous parts and levers found in other turbine regulating gates. This strong and durable design eliminates as many as 35 to 50 small pieces that are required by some turbines of other makes. The saving in wear and in replacements is obvious.

Gate breakage is almost unknown in a Fitz Turbine

Assembly View of Fitz-Hanover Turbine



- (1) Runner shaft is machined down to form a shoulder for the split bonnet that carries the vertical thrust.
- (2) Self-cleaning lignum vitæ thrust bearing with large bearing surface.
- (3) Step bearing collar designed to sling off sand and mud.
- (4) One piece regulating gate, for long life and reliable regulation.
- (5) Phosphor bronze bearing plates, impossible to clog by sand or grit.
- (6) Precision finished steel register pin, bronze bushed.
- (7) Semi-steel rocker fork.
- (8) C. P. hexagon lock-nut.
- (9) Runner with remarkably superior governing qualities, and ability to maintain constant speeds under variable heads. Highly efficient. No buckets projecting below runner band.
- (10) No wood step or spider of any kind below runner.
- (11) Steel draft tube with hydraulically correct taper, to suit location.
- (12) Hand wheel is furnished for manual control when no automatic governor is required. Rock shaft is connected direct to governor by worm gear when automatic control is furnished.
- (13) Cold rolled steel rock shaft.
- (14) Rock shaft lever.
- (15) Forged steel connecting rods, one on each side.
- (16) Bronze lined step box for rock shaft, aligned at factory, and mounted on heavy steel base plate, secured rigidly to turbine.
- (17) Long guide bearing sleeve. May be either water lubricated Micarta, or grease lubricated under pressure in location where water carries much grit.
- (18) Extended pipe for pressure lubrication by alemite grease gun from any convenient point in power house.



Rock-shaft gate mechanism is standard equipment with all Fitz-Hanover Turbines.

Rock shaft gate mechanism for turbines 18" diameter and smaller, is as shown in the illustration above.

Turbines larger than 18" diameter have rock-shaft gate mechanism of the type shown on Pages 4 and 8.

INSTALLATION DIMENSIONS OF FITZ-HANOVER VERTICAL TURBINES

	A	B	C	D	E	F	G	H	J	K	
Wheel Size	Size of Penstock Inside	Depth of Tail Water In Pit	Diameter of Cover Outside	Diameter of Hole In Floor	Length of Shaft from Floor	Diameter of Runner Shaft	Diameter of Upright Shaft	Diameter of Rock Shaft	Submerge Draft Tube	Center To Center Shafts	Diameter of Feed Pipe
10½	36	24	16¾	13½	17½	1 11/16	1 1/8	1 3/8	3	10½	22
12	39	25	18¾	15¼	20	1 11/16	1 7/8	1 7/8	3	12	24
13½	42	26	20¾	16¾	22 1/8	1 11/16	1 11/8	1 7/8	3	13½	27
15	45	27	22¼	18¾	27	2 1/8	1 11/8	1 7/8	3	15	30
16½	48	27	24¼	20½	28 1/8	2 7/8	2 3/8	1 7/8	3	17 1/8	30
18	54	28	26½	22½	30	2 7/8	2 3/8	1 11/8	3	18 7/8	36
21	60	30	30	25¾	33 1/4	2 11/8	2 7/8	1 11/8	4	24½	40
24	66	32	33¾	29 1/8	38	2 11/8	2 11/8	1 11/8	4	27 7/8	45
27	72	34	37¾	32¾	40¾	3 1/8	3 1/8	1 11/8	4	30	48
30	84	40	41¾	32¾	45¾	3 1/8	3 1/8	1 11/8	4	32½	54
36	96	48	49½	42¾	53¼	3 11/8	3 11/8	1 11/8	4	42	60
42	108	54	57¼	49¾	58	4 1/8	4 1/8	3 1/8	5	47 3/8	72

All Dimensions are in inches

Power Table For Fitz-Hanover Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		4	5	6	7	8	9	10	11	12	13
10½"	Horse Power	1.16	1.62	2.12	2.68	3.27	3.91	4.58	5.31	6.02	6.79
	Cu. ft. per min.	182	203	224	242	257	273	288	302	315	329
	Revolutions	371	412	454	489	523	552	585	614	641	667
12"	Horse Power	1.51	2.11	2.76	3.50	4.28	5.10	5.98	6.91	7.86	8.87
	Cu. ft. per min.	238	265	291	315	337	357	375	393	411	429
	Revolutions	323	361	396	428	457	486	512	537	561	584
13½"	Horse Power	1.91	2.67	3.52	4.43	5.42	6.41	7.57	8.71	9.94	11.2
	Cu. ft. per min.	301	337	369	397	424	450	474	499	522	544
	Revolutions	288	321	352	377	408	432	456	476	499	520
15"	Horse Power	2.62	3.30	4.34	5.47	6.69	7.99	9.35	10.79	12.29	13.86
	Cu. ft. per min.	370	417	454	492	526	558	586	616	643	670
	Revolutions	259	289	316	342	366	388	409	430	449	467
16½"	Horse Power	2.85	4.00	5.26	6.62	8.09	9.66	11.3	13.05	14.87	16.77
	Cu. ft. per min.	450	504	550	597	636	675	711	747	781	813
	Revolutions	235	264	288	312	332	353	372	390	408	424
18"	Horse Power	3.40	4.76	6.25	7.88	9.63	11.45	13.47	15.50	17.7	19.9
	Cu. ft. per min.	535	598	657	708	757	805	847	891	930	967
	Revolutions	216	241	264	286	305	323	340	358	374	390
21"	Horse Power	4.63	6.61	8.70	10.96	13.39	15.98	18.72	21.60	23.27	27.74
	Cu. ft. per min.	729	814	892	964	1030	1093	1153	1210	1263	1314
	Revolutions	185	196	227	244	262	278	292	307	320	332
24"	Horse Power	6.18	8.64	10.36	14.30	17.49	20.8	24.4	28.2	32.14	36.2
	Cu. ft. per min.	951	1063	1165	1260	1345	1428	1504	1579	1650	1717
	Revolutions	161	180	198	214	228	243	256	268	280	291
27"	Horse Power	7.82	11.06	14.38	18.12	22.14	26.42	30.96	35.82	40.68	46.02
	Cu. ft. per min.	1206	1350	1476	1590	1698	1800	1896	2001	2088	2173
	Revolutions	144	161	176	190	203	216	227	238	249	259
30"	Horse Power	10.06	14.07	18.49	23.31	28.4	33.9	39.8	45.9	53.3	58.9
	Cu. ft. per min.	1491	1668	1822	1968	2106	2232	2353	2467	2578	2683
	Revolutions	129	145	158	171	184	195	204	214	224	233
36"	Horse Power	14.5	20.2	26.64	33.5	41.01	48.9	57.3	66.1	75.3	84.9
	Cu. ft. per min.	2143	2395	2625	2836	3033	3214	3390	3540	3712	3867
	Revolutions	107	120	132	144	153	163	171	179	187	195

Power Table For Fitz-Hanover Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		14	15	16	17	18	19	20	21	22	23
10½"	Horse Power	7.39	8.42	9.27	10.16	11.07	11.99	12.97	13.95	14.96	15.98
	Cu. ft. per min.	342	354	366	377	387	398	407	419	428	437
	Revolutions	692	716	740	763	785	806	827	848	868	888
12"	Horse Power	9.97	10.9	11.9	13.1	14.4	15.6	16.9	18.2	19.5	21.0
	Cu. ft. per min.	445	462	477	490	504	517	531	544	558	571
	Revolutions	606	627	648	667	686	705	724	742	760	777
13½"	Horse Power	12.5	14.0	15.4	16.6	18.2	19.8	21.4	23.1	24.7	26.4
	Cu. ft. per min.	564	583	603	621	639	657	675	690	706	722
	Revolutions	539	557	576	593	611	627	643	659	675	691
15"	Horse Power	15.49	17.18	18.93	20.73	22.58	24.56	26.45	28.46	30.52	32.61
	Cu. ft. per min.	697	721	745	768	790	811	832	853	873	892
	Revolutions	484	502	518	534	550	564	579	593	608	622
16½"	Horse Power	17.42	20.52	22.89	25.08	27.35	29.6	31.9	34.4	36.8	39.5
	Cu. ft. per min.	843	871	900	927	954	981	1006	1030	1056	1080
	Revolutions	440	456	472	486	500	513	526	539	552	564
18"	Horse Power	22.3	24.6	27.2	29.8	32.5	35.2	37.9	40.9	43.9	46.9
	Cu. ft. per min.	1003	1048	1071	1105	1137	1168	1200	1228	1257	1285
	Revolutions	404	419	432	444	457	470	483	494	507	518
21"	Horse Power	31.01	34.39	37.9	41.5	45.2	49.73	52.96	56.98	61.09	65.30
	Cu. ft. per min.	1363	1413	1458	1503	1548	1590	1629	1669	1710	1749
	Revolutions	345	358	371	382	393	404	414	424	433	443
24"	Horse Power	40.5	44.9	49.4	54.2	59.06	64.04	69.17	74.42	79.79	85.29
	Cu. ft. per min.	1780	1843	1903	1962	2019	2074	2128	2179	2232	2281
	Revolutions	302	313	324	334	344	353	361	371	380	388
27"	Horse Power	51.27	56.86	62.64	68.6	75.01	81.19	87.41	94.57	101.0	107.9
	Cu. ft. per min.	2257	2335	2412	2487	2559	2628	2695	2763	2827	2890
	Revolutions	268	278	288	297	305	313	321	329	337	345
30"	Horse Power	65.9	73.1	80.5	88.2	96.11	104.2	112.5	121.1	129.7	138.8
	Cu. ft. per min.	2785	2881	2976	3070	3159	3244	3330	3411	3492	3570
	Revolutions	243	251	259	267	275	283	289	297	304	310
36"	Horse Power	94.9	105.2	116.0	127.0	138.4	150.1	161.8	174.4	187.0	199.9
	Cu. ft. per min.	4011	4155	4288	4419	4546	4672	4794	4911	5028	5140
	Revolutions	203	209	216	222	228	235	241	248	254	260

Power Table For Fitz-Hanover Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		24	25	26	27	28	29	30	31	32	33
10½"	Horse Power	17.03	18.12	19.22	20.35	21.47	22.63	23.82	25.02	26.24	27.52
	Cu. ft. per min.	446	455	464	473	482	491	500	509	518	527
	Revolutions	907	926	944	961	979	996	1014	1030	1046	1052
12"	Horse Power	22.1	23.6	25.1	26.5	28.0	29.5	31.1	32.6	34.2	36.8
	Cu. ft. per min.	583	597	607	620	631	642	652	663	673	684
	Revolutions	793	809	825	841	857	872	886	902	916	931
13½"	Horse Power	28.1	29.9	31.7	33.6	35.4	37.4	39.3	41.3	43.4	45.4
	Cu. ft. per min.	738	753	768	783	798	811	825	838	852	867
	Revolutions	705	720	734	748	763	776	788	801	814	827
15"	Horse Power	34.78	36.94	39.21	41.50	43.82	46.19	48.6	50.8	53.54	56.07
	Cu. ft. per min.	912	931	949	967	985	1002	1018	1035	1053	1069
	Revolutions	635	648	660	673	686	697	710	721	732	744
16½"	Horse Power	42.08	44.7	47.4	50.2	53.01	55.8	58.8	61.77	64.7	69.16
	Cu. ft. per min.	1102	1125	1147	1170	1192	1215	1234	1252	1273	1294
	Revolutions	577	590	601	612	615	637	644	656	667	678
18"	Horse Power	49.9	53.3	56.4	59.7	63.3	66.5	70.0	73.5	77.1	80.7
	Cu. ft. per min.	1314	1341	1368	1393	1417	1441	1467	1471	1516	1539
	Revolutions	529	540	552	561	571	580	590	601	611	620
21"	Horse Power	69.6	74.01	78.49	83.06	87.59	92.4	97.2	102.2	107.1	112.2
	Cu. ft. per min.	1786	1822	1858	1894	1930	1965	1998	2029	2062	2094
	Revolutions	452	462	472	481	489	499	507	515	523	531
24"	Horse Power	90.9	96.6	102.5	108.4	114.5	120.7	127.0	133.4	139.9	146.6
	Cu. ft. per min.	2331	2380	2427	2472	2517	2562	2607	2650	2692	2734
	Revolutions	396	404	412	420	428	436	443	451	459	467
27"	Horse Power	115.0	122.3	129.7	137.2	145.0	154.1	160.8	169.0	177.3	185.5
	Cu. ft. per min.	2953	3015	3075	3133	3190	3247	3303	3357	3411	3463
	Revolutions	353	361	368	374	380	387	393	400	406	412
30"	Horse Power	148.0	157.3	166.8	176.6	186.4	196.5	206.8	217.2	227.8	238.6
	Cu. ft. per min.	3646	3721	3795	3867	3939	4009	4077	4144	4212	4276
	Revolutions	316	323	329	336	342	348	353	360	366	372
36"	Horse Power	213.1	226.5	240.2	254.3	268.5	283.0	297.8	312.8	328.1	343.6
	Cu. ft. per min.	5251	5359	5464	5571	5671	5772	5872	5968	6063	6157
	Revolutions	267	272	276	281	286	291	296	300	305	310

Power Table For Fitz-Hanover Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

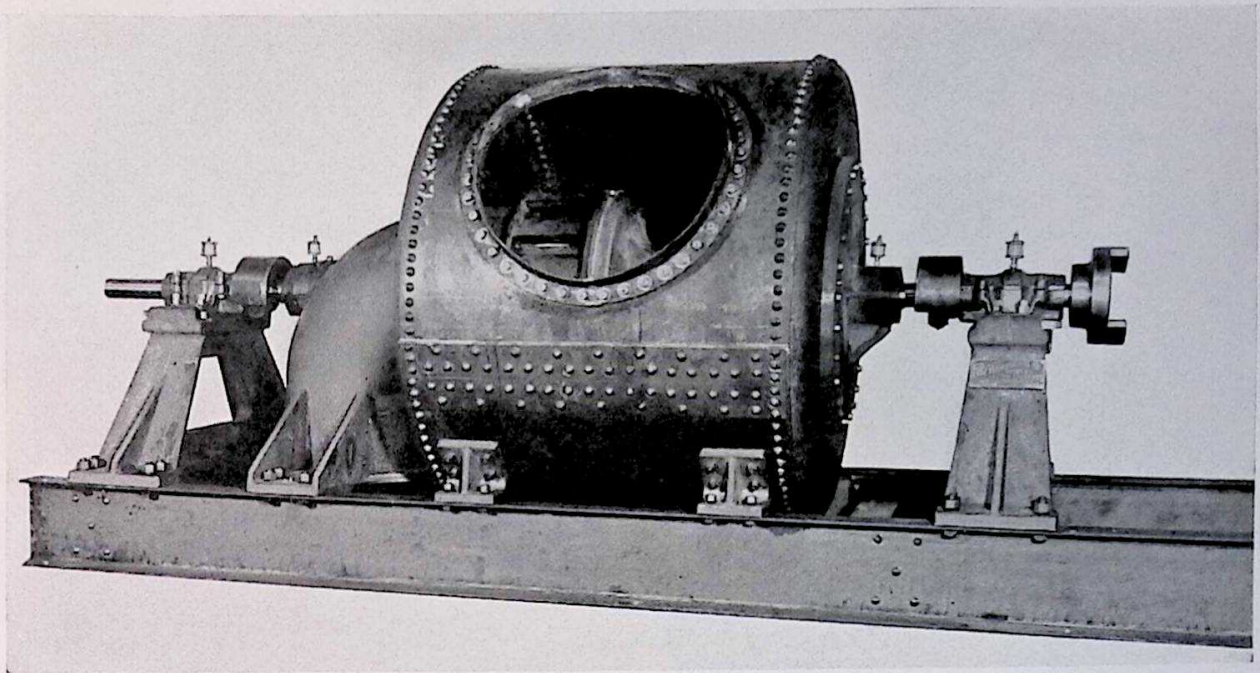
Size of Turbine	WORKING HEAD OF WATER IN FEET									
	34	35	36	37	38	39	40	42	44	46
10½"	Horse Power	28.7	30.0	31.3	32.6	33.9	35.3	36.6	39.4	45.2
	Cu. ft. per min.	538	543	551	558	564	570	576	593	620
	Revolutions	1078	1094	1110	1126	1142	1156	1171	1200	1257
12"	Horse Power	37.5	39.1	40.8	42.6	44.3	46.1	47.8	51.5	59.1
	Cu. ft. per min.	695	705	717	724	733	742	751	769	805
	Revolutions	945	960	972	985	998	1011	1024	1049	1099
13½"	Horse Power	47.4	49.6	51.7	53.9	56.8	58.3	60.5	65.0	74.8
	Cu. ft. per min.	879	892	906	918	930	940	951	976	1020
	Revolutions	840	852	865	876	888	899	910	932	977
15"	Horse Power	57.19	61.24	63.9	66.57	69.41	72.0	74.8	80.5	92.2
	Cu. ft. per min.	1086	1101	1116	1131	1146	1161	1176	1206	1263
	Revolutions	755	766	777	788	800	809	819	840	878
16½"	Horse Power	70.95	74.11	77.26	80.5	83.8	87.03	90.5	97.3	111.6
	Cu. ft. per min.	1314	1333	1351	1369	1387	1407	1423	1465	1533
	Revolutions	688	697	707	716	726	736	745	764	800
18"	Horse Power	84.4	88.2	90.6	95.7	99.6	103.7	107.7	115.9	132.9
	Cu. ft. per min.	1561	1584	1606	1629	1651	1674	1695	1740	1818
	Revolutions	630	640	649	659	667	675	683	699	731
21"	Horse Power	117.3	122.5	127.8	133.2	138.7	143.2	149.7	161.0	184.7
	Cu. ft. per min.	2125	2157	2188	2218	2248	2277	2305	2363	2472
	Revolutions	539	547	555	563	571	579	585	600	627
24"	Horse Power	153.3	160.1	167.0	173.9	181.1	188.3	195.6	210.5	241.2
	Cu. ft. per min.	2775	2817	2856	2895	2934	2973	3010	3086	3229
	Revolutions	473	480	486	492	499	505	512	526	551
27"	Horse Power	194.0	202.6	211.4	220.2	229.2	238.4	247.6	266.4	305.3
	Cu. ft. per min.	3516	3568	3618	3667	3717	3766	3813	3907	4088
	Revolutions	419	425	432	438	444	449	454	466	488
30"	Horse Power	249.4	260.6	271.8	283.2	294.8	306.5	318.4	342.6	392.7
	Cu. ft. per min.	4339	4402	4467	4527	4588	4648	4707	4823	5046
	Revolutions	379	385	390	395	400	404	409	421	440
36"	Horse Power	359.3	375.3	391.4	407.9	424.5	441.4	458.5	493.3	565.5
	Cu. ft. per min.	6250	6342	6432	6520	6607	6693	6778	6946	7268
	Revolutions	315	320	324	329	334	337	340	349	366

Power Table For Fitz-Hanover Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		48	50	52	54	56	58	60	62	64	66
10½"	Horse Power	48.2	51.2	54.3	57.5	60.7	64.0	67.3	70.7	74.2	77.7
	Cu. ft. per min.	633	645	657	669	681	693	705	717	729	741
	Revolutions	1296	1308	1334	1360	1385	1422	1433	1457	1481	1504
12"	Horse Power	62.9	66.8	71.0	75.1	79.2	83.6	86.9	92.4	96.8	101.5
	Cu. ft. per min.	823	840	858	876	891	906	921	936	951	966
	Revolutions	1121	1144	1168	1190	1212	1235	1254	1275	1296	1315
13½"	Horse Power	79.6	85.7	89.7	95.0	100.4	104.3	111.2	116.9	122.7	128.5
	Cu. ft. per min.	1041	1060	1081	1104	1125	1146	1164	1183	1206	1224
	Revolutions	1000	1019	1041	1060	1080	1099	1116	1136	1155	1174
15"	Horse Power	98.3	105.6	110.9	117.3	123.9	130.6	137.4	144.3	150.4	158.5
	Cu. ft. per min.	1290	1317	1344	1368	1392	1416	1440	1464	1488	1512
	Revolutions	897	915	934	953	971	987	1003	1019	1036	1052
16½"	Horse Power	119.0	126.5	134.2	143.1	149.9	158.0	167.2	174.6	183.3	191.8
	Cu. ft. per min.	1564	1594	1627	1657	1687	1717	1747	1777	1807	1837
	Revolutions	817	833	852	872	888	902	915	931	947	961
8"	Horse Power	141.5	150.5	159.7	168.1	178.4	188.1	197.9	207.9	218.1	227.5
	Cu. ft. per min.	1854	1890	1926	1962	1998	2034	2070	2106	2142	2175
	Revolutions	747	763	779	795	809	822	835	849	854	872
21"	Horse Power	196.8	209.2	222.0	235.0	248.1	261.6	275.1	289.0	303.0	317.5
	Cu. ft. per min.	2516	2578	2625	2676	2728	2771	2822	2870	2917	2961
	Revolutions	639	654	666	679	692	703	716	728	740	752

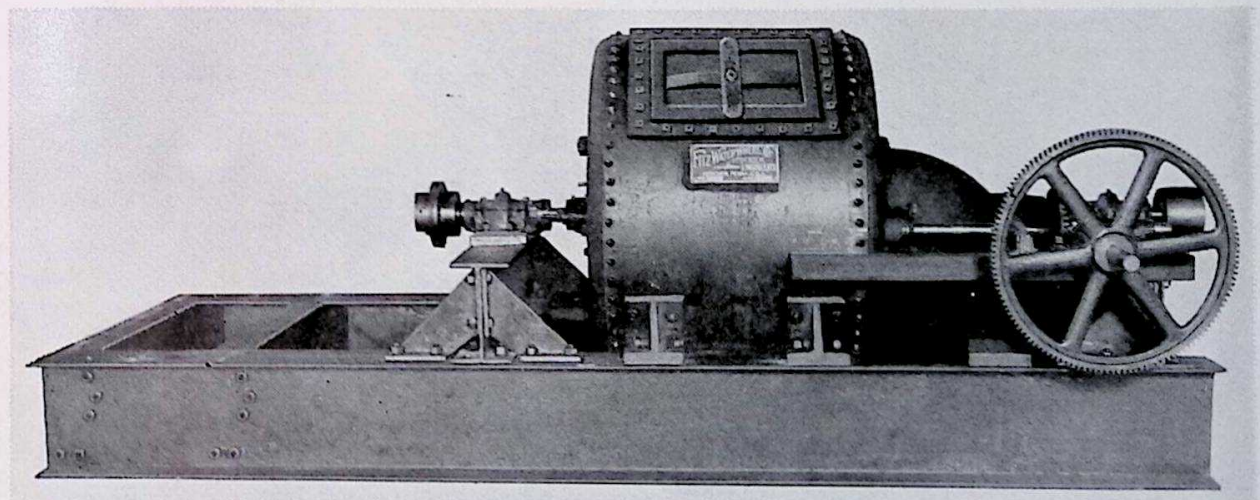
Size of Turbine		WORKING HEAD OF WATER IN FEET									
		68	70	72	74	76	78	80	85	90	95
10½"	Horse Power	81.2	84.8	88.5	92.1	96.0	99.8	103.7	113.5	123.7	135.5
	Cu. ft. per min.	753	762	774	786	797	805	815	838	864	889
	Revolutions	1526	1548	1571	1593	1616	1635	1654	1702	1753	1803
12"	Horse Power	106.0	110.6	114.3	120.4	125.4	130.4	135.5	148.3	161.6	175.3
	Cu. ft. per min.	978	990	1008	1024	1039	1051	1062	1095	1128	1160
	Revolutions	1336	1355	1374	1393	1411	1430	1448	1490	1535	1580
13½"	Horse Power	134.3	140.3	146.4	152.4	157.3	165.0	171.4	187.8	204.5	221.8
	Cu. ft. per min.	1242	1260	1278	1296	1311	1326	1341	1386	1428	1469
	Revolutions	1193	1212	1232	1248	1265	1281	1299	1324	1365	1404
15"	Horse Power	165.8	173.1	180.6	188.0	195.9	203.7	211.6	231.8	251.4	273.8
	Cu. ft. per min.	1536	1557	1578	1591	1612	1632	1665	1711	1763	1814
	Revolutions	1068	1083	1099	1113	1129	1144	1160	1205	1232	1267
16½"	Horse Power	200.7	209.8	218.8	227.8	237.1	246.4	256.1	283.1	305.6	331.3
	Cu. ft. per min.	1866	1893	1923	1950	1977	2002	2026	2254	2322	2389
	Revolutions	976	988	1001	1016	1030	1044	1057	1085	1118	1150
18"	Horse Power	237.4	249.4	260.2	271.1	282.1	293.3	303.4	333.7	365.0	394.4
	Cu. ft. per min.	2208	2241	2271	2301	2331	2361	2389	2465	2540	2613
	Revolutions	889	902	915	928	940	953	966	993	1023	1053
21"	Horse Power	332.0	346.7	361.6	376.9	392.2	407.8	423.6	464.0	505.5	548.2
	Cu. ft. per min.	3005	3048	3092	3136	3180	3220	3260	3358	3457	3552
	Revolutions	763	774	785	796	807	817	828	853	870	902



21" Fitz-Hanover Turbine, mounted horizontally in steel pressure case; with steel I-beam base, extended to receive Westinghouse A. C. Generator.

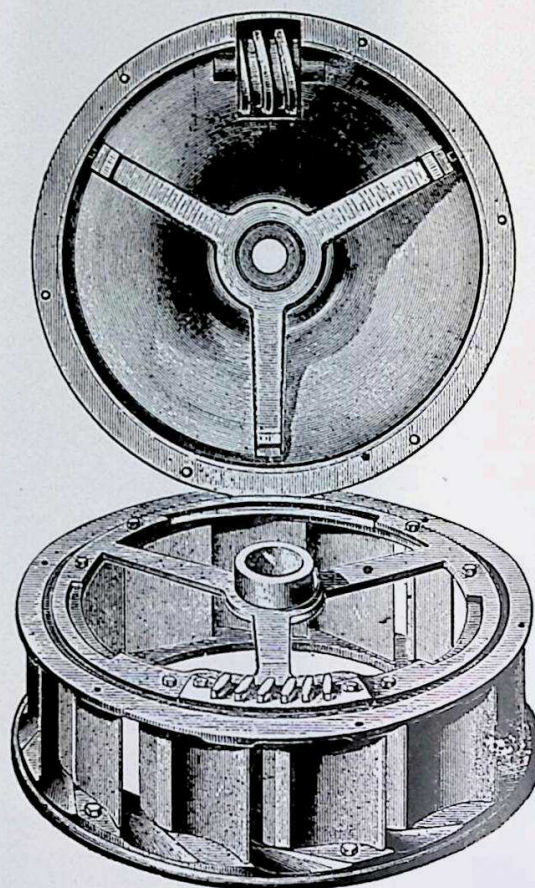
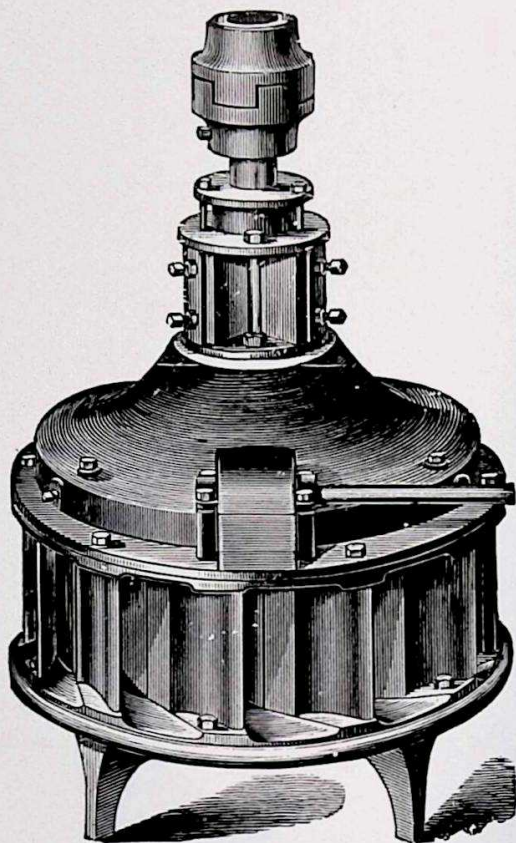
The generator shaft is coupled direct to the turbine shaft by means of a flexible coupling. Since both the turbine and the generator are accurately levelled and aligned in our factory and securely mounted on a single heavy steel base, there is no possibility of misalignment or distortion when assembled in the field. Please note substantial bridge-trees, and our method of supporting the discharge elbow and draft tube.

Horizontally mounted turbines require higher falls than vertical turbines and should not be used under very low heads.

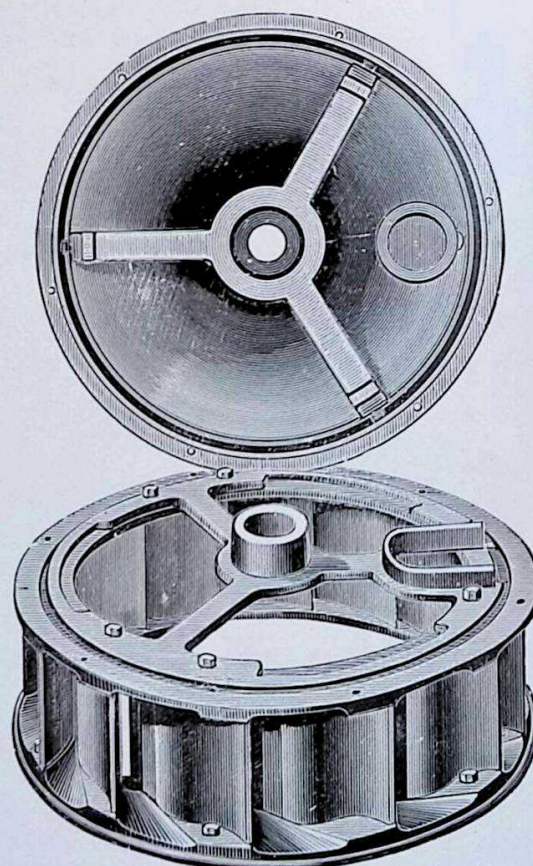
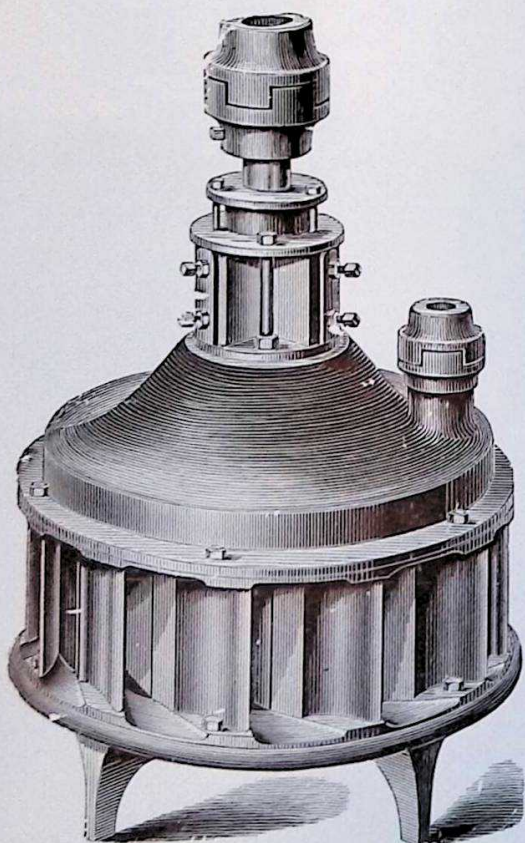


First Water Wheel to Travel by Airplane.

This 12" Fitz-Hanover Turbine in steel case for 60' head is direct-connected to a 1200 RPM Westinghouse A. C. Generator. The turbine and governor were taken apart after being assembled in our factory, for shipment to La Ceiba, Honduras; then flown by airplane over the mountains to light the City of Yoro far back in the interior. This was the first time a water wheel had travelled by airplane. The Fitz Turbine was selected for this location, after careful comparisons by American engineers, on account of its completely dependable service and freedom from need for repairs.



Fitz-Burnham Turbine with Worm Geared Gate Mechanism.



Fitz-Burnham Turbine with Eccentric Gate Mechanism.

The Fitz-Burnham Turbine

In the improved Fitz-Burnham Turbine we have retained all of the features that have made the Burnham Turbine so well liked by its thousands of satisfied users. Recent improvements have still further increased its high efficiency and have added to its convenience.

The Fitz-Burnham Turbine serves a broad range of conditions for which no other turbine on the market is so well fitted. Its splendid reputation has been earned by efficient and reliable performance thru many years of continuous use. Its speed is less than that of a Fitz-Hanover Turbine of the same diameter, and its capacity is smaller, but both of these features are of great advantage in many locations.

The speed can be stepped up to an electric generator or other high speed machinery by one of the efficient methods we have devised for that purpose, as illustrated later on in this booklet. With this system a standard speed generator can be used. Both the water wheel and the generator are run at the exact speeds for which they were designed. That is one of the reasons why the over-all efficiency of a complete Fitz Hydro-electric Unit is much the highest of any in the small water power field.

The regulating gate of the Fitz-Burnham Turbine is made in one single piece, just like the Fitz-Hanover gate, free from all of the numerous links and pins that cause so much wear and breakage in other types of turbines. Small sticks and branches that would break the ordinary turbine gate are cut off by our one piece gate. No Fitz-Burnham gate has ever been broken in all of our experience. Phosphor-bronze bearing plates now protect the wearing surfaces from gritty sand or dirty water and enable the gate to be regulated with much greater ease than in the older models.

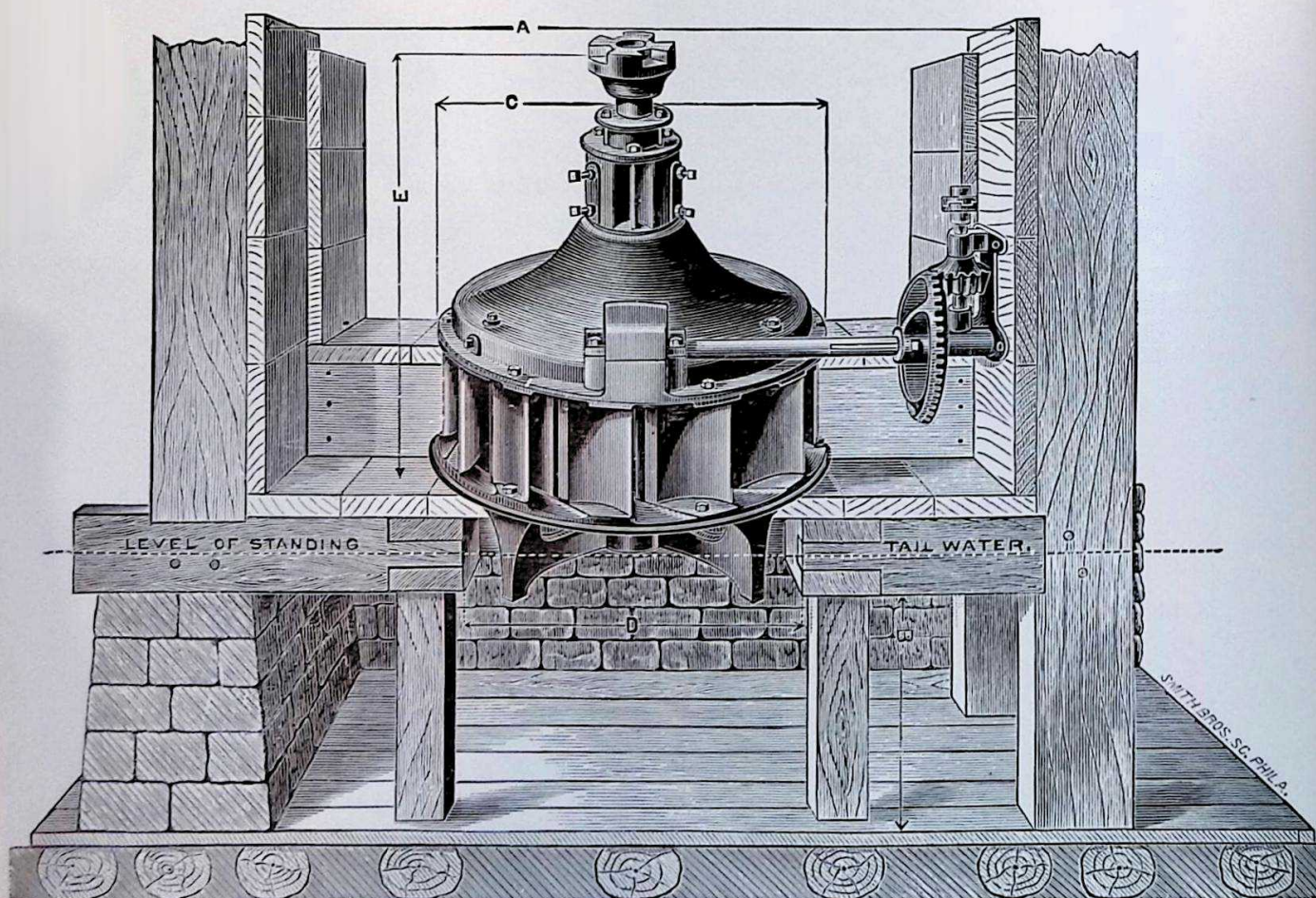
Fitz-Burnham buckets are made shallow and they are set farther out from the center of the wheel than in other turbines. These features enable the wheel to set lower under the water, and to take in water over a wider area. Consequently, this type of turbine will operate successfully under much lower heads than any other turbine. The Burnham is remarkably free from clogging with leaves or sticks or trash of any kind.

The design of our runner permits it to operate under back-water conditions or in floods, with the least possible resistance. Consequently no draft tube is required for the Fitz-Burnham Turbine, when it is mounted vertically. The wheel can be set down close to the surface of the tail water, and can run submerged without loss of power. This is a very valuable advantage in locations where back water is frequently encountered.

In spite of the larger diameter required for consuming the same amount of water, the cost of a Fitz-Burnham Turbine is usually less than

that of a Fitz-Hanover of equal capacity. Standard gate-operating mechanism may be either of the eccentric type or worm geared type. The eccentric type is usually preferable for small diameter wheels except where they are to be operated under fairly high heads. When automatic regulation is to be used, the Fitz-Burnham can be equipped with our rock-shaft gate mechanism at an extra cost.

Fitz-Burnham Turbines can be equipped either with right-hand runners (revolving clockwise) or with left hand runners (turning counter-clockwise). Right-hand runners are usually furnished when no direction of rotation is specified by the purchaser. The speed can be stepped up to a generator or other machinery by any of the various methods illustrated in this catalog that apply to Fitz-Hanover Turbines.

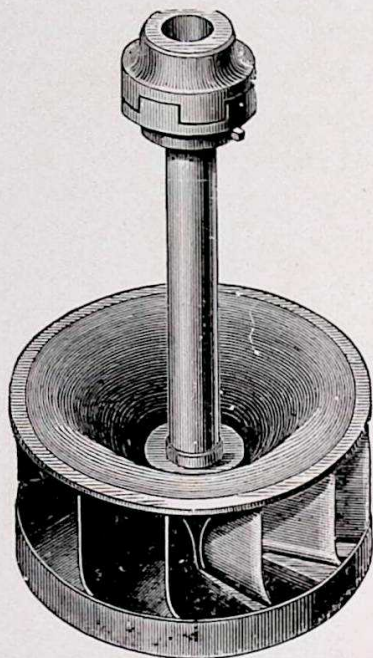


Fitz-Burnham Turbine installed in wood penstock. For dimensions see table on Page 19

Table of Principal Measurements of Fitz-Burnham Turbines and Penstocks

Size of wheels	A Size of penstocks inside	B Depth of tail-water in pit	C Diameter of wheel case outside	D Diameter of cylinder on wheel case	E Length of wheel shaft from floor	Bore of wheel shaft coupling	Length of worm gear shaft from center of wheel	ECCENTRIC GATE GEARING			Dia. of Feed Pipe
								Length of gate shaft from floor	Bore of gate shaft coupling	Space bet. centers of wheel and gate shafts	
9	30	20	13 $\frac{3}{8}$	12 $\frac{1}{4}$	21 $\frac{1}{2}$	1 $\frac{3}{8}$	14	9 $\frac{1}{2}$	1 $\frac{1}{8}$	4 $\frac{1}{4}$	13 $\frac{1}{2}$
10 $\frac{1}{2}$	33	21	15	13 $\frac{5}{8}$	23 $\frac{1}{2}$	1 $\frac{1}{2}$	15 $\frac{1}{2}$	10 $\frac{1}{2}$	1 $\frac{1}{8}$	5	15
12	36	22	17	15 $\frac{1}{2}$	25 $\frac{3}{4}$	1 $\frac{5}{8}$	17	11 $\frac{3}{4}$	1 $\frac{1}{4}$	5 $\frac{5}{8}$	18
13 $\frac{1}{2}$	39	23	18 $\frac{3}{4}$	17 $\frac{1}{4}$	28	1 $\frac{3}{4}$	18 $\frac{1}{2}$	12 $\frac{3}{4}$	1 $\frac{1}{4}$	6 $\frac{1}{2}$	20
15	42	24	20 $\frac{7}{8}$	19 $\frac{1}{4}$	29 $\frac{1}{2}$	1 $\frac{7}{8}$	20	13 $\frac{5}{8}$	1 $\frac{3}{8}$	7 $\frac{1}{4}$	22
16 $\frac{1}{2}$	45	25	22 $\frac{7}{8}$	20 $\frac{3}{4}$	31 $\frac{1}{2}$	2 $\frac{1}{8}$	21 $\frac{1}{2}$	14 $\frac{3}{8}$	1 $\frac{3}{8}$	7 $\frac{7}{8}$	24
18	48	26	24 $\frac{7}{8}$	22 $\frac{3}{4}$	33	2 $\frac{3}{8}$	23	15	1 $\frac{1}{2}$	8 $\frac{5}{8}$	27
21	54	28	28 $\frac{1}{4}$	25 $\frac{3}{4}$	37	2 $\frac{5}{8}$	26	16 $\frac{1}{2}$	1 $\frac{1}{2}$	10 $\frac{1}{8}$	30
24	60	30	33	29 $\frac{1}{2}$	40 $\frac{3}{4}$	2 $\frac{7}{8}$	29	18 $\frac{1}{8}$	1 $\frac{5}{8}$	11 $\frac{5}{8}$	33
27	66	32	36	33 $\frac{3}{8}$	44 $\frac{1}{4}$	3 $\frac{1}{8}$	32	19 $\frac{5}{8}$	1 $\frac{5}{8}$	13 $\frac{1}{8}$	36
30	72	34	40	37 $\frac{1}{2}$	48 $\frac{1}{2}$	3 $\frac{3}{8}$	34	21 $\frac{1}{4}$	1 $\frac{3}{4}$	14 $\frac{5}{8}$	42
36	84	38	48	43 $\frac{3}{4}$	56	3 $\frac{7}{8}$	40	23 $\frac{3}{4}$	1 $\frac{7}{8}$	17 $\frac{1}{2}$	48
42	96	42	55 $\frac{5}{8}$	51 $\frac{1}{4}$	61 $\frac{1}{2}$	4 $\frac{3}{8}$	46	26 $\frac{3}{8}$	2	20 $\frac{1}{2}$	56
48	108	46	63 $\frac{1}{4}$	58	68	4 $\frac{7}{8}$	52	29 $\frac{1}{4}$	2 $\frac{1}{8}$	23 $\frac{3}{8}$	66
54	120	50	71	62 $\frac{5}{8}$	76 $\frac{3}{4}$	5 $\frac{3}{8}$	58	32 $\frac{1}{4}$	2 $\frac{1}{4}$	26 $\frac{3}{8}$	78
60	132	54	78 $\frac{3}{4}$	69 $\frac{1}{2}$	81 $\frac{1}{2}$	5 $\frac{7}{8}$	64	35 $\frac{1}{2}$	2 $\frac{3}{8}$	29	90

All Dimensions are in Inches.

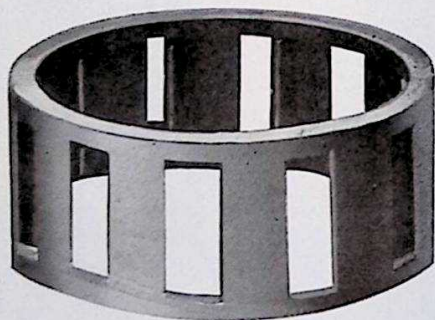


The Runner of a Fitz-Burnham Turbine

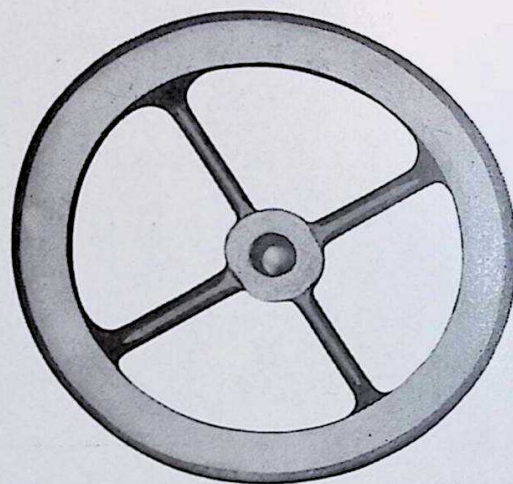
Our Burnham buckets are made shallow to admit a smaller amount of water than those of other turbines of the same diameter. They are set farther out from the center, to secure a greater leverage and to distribute the intake over a wider area. The diameter of a wheel of this type is considerably larger than that of a deep-bucket wheel using the same amount of water.

These features are important advantages under high heads where a wheel of unduly small diameter would choke too easily with leaves or trash. Their value can not be overestimated for low heads where a deep bucket wheel will cause whirlpools destructive of power. This wheel can operate efficiently under much lower heads than other turbines.

Burnham runners work well under back-water conditions. There is no outward bulge to cause friction when submerged in floods.



Fitz - Burnham Regulating Gate.
Made in one single piece, strong
and durable.

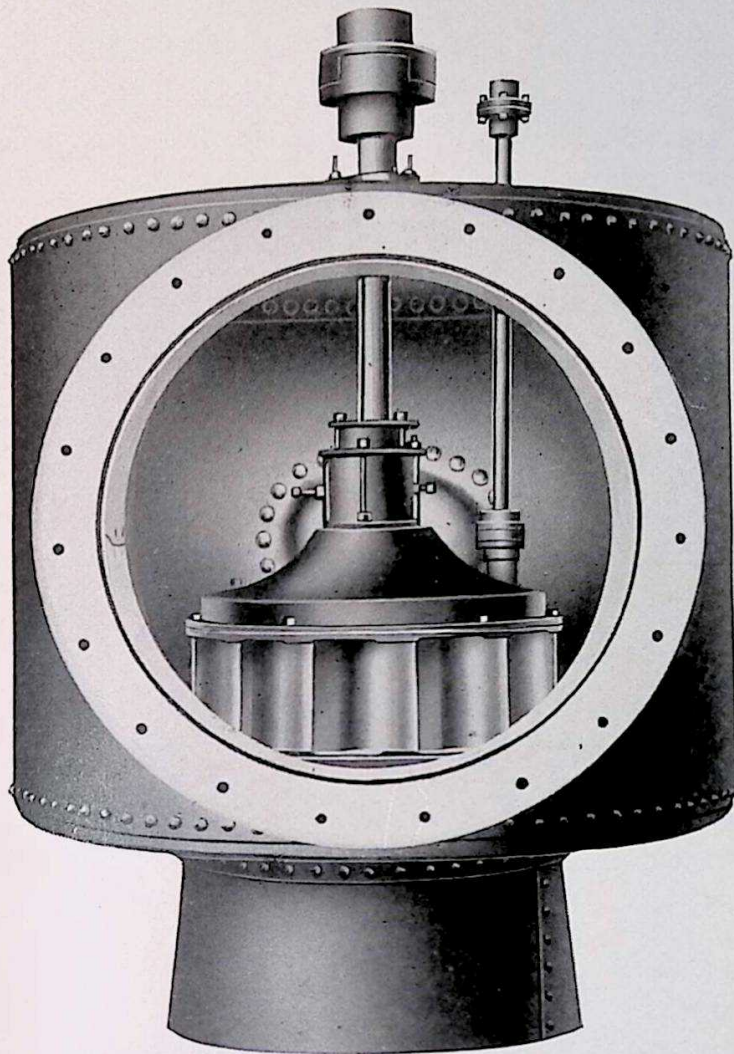


Fitz-Burnham Base Ring with
Lignum Vitæ Step Block

The vertical downward thrust of a standard type Burnham Turbine is carried by a water lubricated lignum-vitæ step, similar to the device used in other types of turbines with the exception of the Fitz-Hanover.

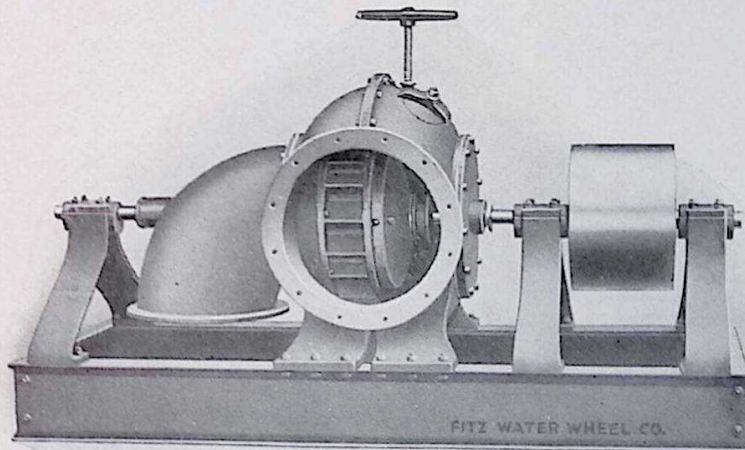
This design has proved very satisfactory for the Burnham turbine, owing to the special characteristics of our runner. The slower speed of the Burnham runner, and its larger diameter, cause it to discharge the water at a much lower velocity than other turbines do. Consequently the water passes out between the spokes of the base ring (spider) with much less resistance than is incurred in a higher speed turbine.

The dome or cover of the Burnham Turbine encloses a large low-pressure area which reduces the downward thrust of the turbine and lessens the weight on the lignum vitæ step when the wheel is in operation. Our step bearings are notable for their long lives.



Vertical Fitz - Burnham Turbine Mounted in Steel Case

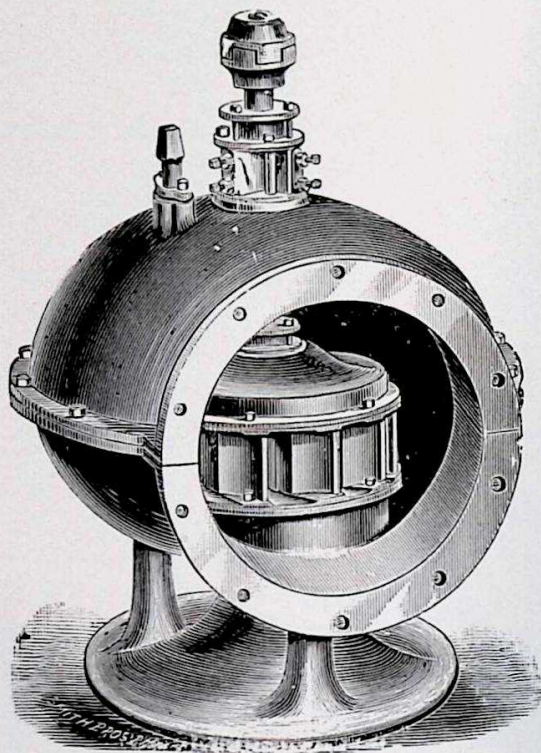
Under quite low heads, the turbine can be mounted most economically in a home-made wood or concrete box, similar to the plans on pages 18 and 29. For heads of more than 12 ft. an iron or steel case is usually less expensive than concrete as well as being still more durable. When we furnish a metal case the turbine is mounted in it at the factory, thus eliminating much of the installation work.



Fitz-Burnham Mounted Horizontally for Belt Drive

Horizontal wheels take up very little space, have water tight cases, ring-oiling bearings, and are self contained in every respect. They are very convenient for driving dynamos, pumps or other machinery of similar types, as the power can be transmitted by a single straight horizontal belt.

This type of mounting costs considerably more than vertical mounting. It should not be used on very low heads.



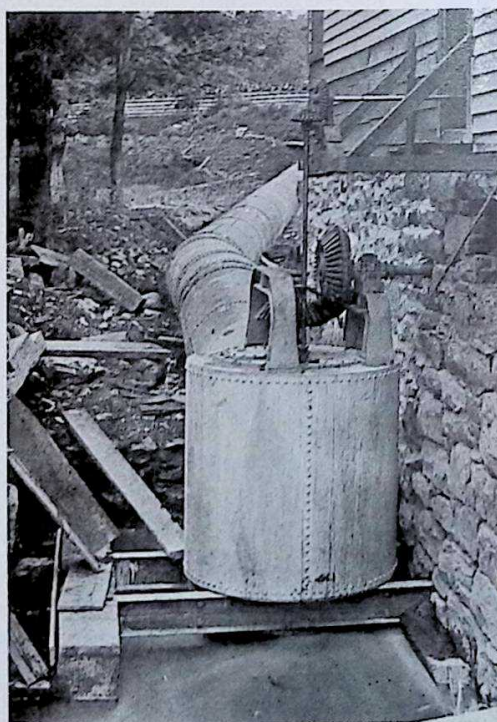
Vertical Fitz-Burnham Turbine in Cast Iron Globe Case

A strong compact and serviceable case for hand-regulated Burnhams up to and including the 15" size. For larger wheels the cases are made of heavy steel plates as shown in the illustration below, and also on page 21, and elsewhere.

Turbine Mounted in Steel Case, with Fitz Riveted Pipe to Carry Water from Dam

This makes a very neat and convenient installation. In the long run a complete steel flume and case will always be found more truly economical than any other method.

The pipe can follow the lay of the land as shown, or it can be buried underground to pass under a highway, etc.



Power Table For Fitz-Burnham Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		3	4	5	6	7	8	9	10	11	12
9"	Horse Power	.27	.42	.57	.76	.96	1.17	1.40	1.63	1.89	2.16
	Cu. ft. per min.	57	66	75	81	88	94	100	105	111	115
	Revolutions	232	270	302	330	358	382	404	426	448	468
10½"	Horse Power	.36	.56	.78	1.02	1.31	1.59	1.90	2.23	2.56	2.92
	Cu. ft. per min.	78	90	101	111	120	128	136	144	150	157
	Revolutions	200	232	258	284	306	327	348	366	384	401
12"	Horse Power	.52	.80	1.12	1.44	1.83	2.23	2.66	3.11	3.57	4.08
	Cu. ft. per min.	110	127	141	155	168	180	190	200	209	219
	Revolutions	175	202	226	248	268	286	304	320	336	351
13½"	Horse Power	.64	1.00	1.39	1.82	2.30	2.80	3.36	3.94	4.53	5.17
	Cu. ft. per min.	139	160	180	196	212	226	240	252	266	278
	Revolutions	156	180	201	220	236	255	270	285	298	312
15"	Horse Power	.89	1.37	1.93	2.53	3.21	3.93	4.68	5.46	6.31	7.18
	Cu. ft. per min.	193	222	249	272	295	315	334	351	370	387
	Revolutions	140	162	181	198	214	229	243	256	269	281
16½"	Horse Power	1.08	1.68	2.35	3.08	3.87	4.75	5.65	6.62	7.65	8.72
	Cu. ft. per min.	233	270	303	331	358	382	405	427	449	469
	Revolutions	128	147	165	180	195	208	221	233	244	255
18"	Horse Power	1.44	2.21	3.10	4.08	5.13	6.27	7.47	8.72	10.13	11.52
	Cu. ft. per min.	309	357	399	438	472	505	537	565	594	620
	Revolutions	117	135	151	165	179	191	202	213	224	234
21"	Horse Power	1.97	3.02	4.22	5.49	6.99	8.52	10.16	11.93	13.76	15.65
	Cu. ft. per min.	421	486	543	595	643	687	729	769	807	842
	Revolutions	100	116	129	142	153	164	174	183	192	200
24"	Horse Power	2.55	3.93	5.51	7.22	9.12	11.12	13.29	15.56	17.96	20.45
	Cu. ft. per min.	549	634	709	777	840	897	952	1003	1053	1100
	Revolutions	88	101	113	124	134	143	152	160	168	175
27"	Horse Power	3.24	5.00	6.96	9.12	11.52	14.04	16.83	19.70	22.74	25.89
	Cu. ft. per min.	696	804	900	984	1060	1132	1200	1264	1334	1392
	Revolutions	78	90	101	110	119	127	135	142	149	156
30"	Horse Power	3.96	6.15	8.60	11.30	14.24	17.26	20.66	24.32	28.05	31.98
	Cu. ft. per min.	866	994	1112	1215	1312	1404	1488	1569	1645	1719
	Revolutions	70	81	91	99	107	115	122	128	134	140
36"	Horse Power		8.86	12.37	16.27	20.55	25.08	29.90	35.04	40.41	46.08
	Cu. ft. per min.		1429	1597	1750	1891	2022	2143	2260	2360	2475
	Revolutions		67	75	83	90	96	102	107	112	117
42"	Horse Power		12.67	17.74	23.28	29.34	35.82	42.76	50.10	58.27	65.85
	Cu. ft. per min.		2044	2284	2503	2704	2889	3066	3232	3390	3540
	Revolutions		58	65	71	77	82	87	92	96	100
48"	Horse Power		16.22	22.97	30.12	37.95	46.35	55.32	64.80	74.57	85.18
	Cu. ft. per min.		2644	2956	3238	3498	3739	3966	4185	4384	4579
	Revolutions		51	57	62	67	72	76	80	84	88

Power Table For Fitz-Burnham Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		13	14	15	16	17	18	19	20	21	22
9"	Horse Power	2.43	2.70	3.00	3.30	3.63	3.96	4.29	4.63	4.98	5.36
	Cu. ft. per min.	120	124	129	133	138	142	146	150	153	157
	Revolutions	487	505	523	540	557	573	588	603	619	633
10½"	Horse Power	3.30	3.69	4.10	4.52	4.95	5.39	5.85	6.22	6.81	7.29
	Cu. ft. per min.	164	171	177	183	188	193	198	203	209	213
	Revolutions	417	433	448	463	477	491	504	517	530	543
12"	Horse Power	4.61	5.16	5.73	6.31	6.88	7.49	8.12	8.78	9.45	10.15
	Cu. ft. per min.	228	237	246	254	261	268	276	283	290	297
	Revolutions	365	379	392	405	417	429	441	453	464	475
13½"	Horse Power	5.85	6.54	7.22	7.97	8.72	9.50	10.32	11.16	11.98	12.85
	Cu. ft. per min.	290	300	311	321	331	340	350	360	368	376
	Revolutions	325	337	349	360	371	382	392	402	412	422
15"	Horse Power	8.11	9.07	10.04	11.07	12.13	13.22	14.33	15.48	16.65	17.86
	Cu. ft. per min.	402	418	432	447	460	474	486	499	512	523
	Revolutions	292	303	314	324	334	344	353	362	371	380
16½"	Horse Power	9.81	10.94	12.15	13.39	14.66	15.97	17.32	18.71	20.12	21.58
	Cu. ft. per min.	487	505	522	539	556	572	588	603	618	633
	Revolutions	265	275	285	295	304	313	321	329	337	345
18"	Horse Power	12.95	14.45	16.05	17.70	19.41	21.14	22.94	24.78	26.67	28.59
	Cu. ft. per min.	645	669	692	714	737	758	779	800	819	838
	Revolutions	244	253	262	270	278	286	294	302	309	317
21"	Horse Power	17.66	19.73	21.90	24.11	26.40	28.76	31.19	33.66	36.22	38.88
	Cu. ft. per min.	876	909	942	972	1002	1032	1060	1086	1113	1140
	Revolutions	208	216	224	232	239	246	253	259	265	271
24"	Horse Power	23.06	25.76	28.56	31.47	34.46	37.55	40.75	44.00	47.31	50.74
	Cu. ft. per min.	1145	1187	1229	1269	1308	1346	1383	1419	1453	1488
	Revolutions	182	189	196	203	209	215	221	226	232	238
27"	Horse Power	29.19	32.64	36.19	39.87	43.68	47.58	51.60	55.71	59.95	64.29
	Cu. ft. per min.	1449	1505	1557	1608	1658	1706	1752	1797	1842	1885
	Revolutions	162	168	174	180	186	191	196	201	206	211
30"	Horse Power	36.06	40.29	44.67	49.22	53.90	58.70	63.71	68.82	74.02	79.38
	Cu. ft. per min.	1789	1857	1921	1984	2047	2106	2163	2220	2274	2328
	Revolutions	146	152	157	162	167	172	177	181	186	190
36"	Horse Power	51.93	58.07	64.35	70.90	77.61	84.58	91.74	99.09	106.5	114.3
	Cu. ft. per min.	2577	2674	2770	2859	2946	3031	3115	3196	3274	3352
	Revolutions	122	127	131	135	139	143	147	151	155	159
42"	Horse Power	74.24	82.93	92.04	101.5	111.0	121.0	131.2	141.6	152.4	163.4
	Cu. ft. per min.	3684	3823	3956	4087	4213	4336	4455	4570	4683	4794
	Revolutions	104	108	112	116	120	123	126	129	133	136
48"	Horse Power	96.06	107.3	119.1	131.1	143.6	156.4	169.7	183.3	197.2	211.4
	Cu. ft. per min.	4763	4947	5125	5289	5451	5608	5763	5913	6058	6201
	Revolutions	92	95	98	101	104	107	110	113	116	119

Power Table For Fitz-Burnham Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		23	24	25	26	27	28	29	30	31	32
9"	Horse Power	5.73	6.11	6.49	6.90	7.30	7.71	8.11	8.52	8.97	9.42
	Cu. ft. per min.	161	165	168	171	174	177	180	183	186	189
	Revolutions	647	661	675	688	701	714	727	739	752	764
10½"	Horse Power	7.77	8.29	8.82	9.36	9.90	10.46	11.02	11.61	12.21	12.82
	Cu. ft. per min.	218	222	227	231	236	240	245	249	254	258
	Revolutions	555	567	579	590	601	612	623	631	644	654
12"	Horse Power	10.85	11.56	12.28	13.00	13.76	14.55	15.36	16.17	17.00	19.81
	Cu. ft. per min.	304	311	317	324	330	336	342	348	353	359
	Revolutions	486	496	506	516	526	536	545	554	564	573
13½"	Horse Power	13.74	14.64	15.57	16.53	17.51	18.49	19.48	20.47	21.50	22.56
	Cu. ft. per min.	385	393	401	409	417	425	432	440	447	454
	Revolutions	432	441	450	459	468	477	485	493	501	509
15"	Horse Power	19.10	20.38	21.66	22.95	24.30	25.65	27.00	28.44	29.88	31.32
	Cu. ft. per min.	535	547	558	569	580	591	601	611	621	631
	Revolutions	389	397	405	413	421	429	436	444	451	458
16½"	Horse Power	23.09	24.62	26.16	27.73	29.37	31.05	32.70	34.39	36.12	37.89
	Cu. ft. per min.	648	661	675	688	702	715	729	740	751	764
	Revolutions	353	361	369	376	383	390	397	403	410	417
18"	Horse Power	30.54	32.58	34.63	36.73	38.85	41.00	43.18	45.38	47.79	50.13
	Cu. ft. per min.	857	876	894	912	929	945	961	977	994	1011
	Revolutions	324	331	338	345	351	357	363	369	376	382
21"	Horse Power	41.55	44.31	47.08	49.88	52.86	55.86	58.86	61.93	65.01	68.22
	Cu. ft. per min.	1166	1191	1215	1239	1263	1287	1310	1332	1353	1375
	Revolutions	277	283	289	295	301	306	312	317	322	327
24"	Horse Power	54.21	57.81	61.50	65.20	68.92	72.84	76.80	80.83	84.90	89.05
	Cu. ft. per min.	1521	1554	1587	1618	1648	1678	1708	1738	1767	1795
	Revolutions	243	248	253	258	263	268	273	277	282	287
27"	Horse Power	68.71	73.16	77.73	82.56	87.43	92.31	97.29	102.3	107.5	112.7
	Cu. ft. per min.	1927	1969	2010	2050	2089	2127	2165	2202	2238	2274
	Revolutions	216	221	226	230	234	238	242	246	250	254
30"	Horse Power	84.87	90.45	96.13	102.0	107.9	114.0	120.1	126.3	132.7	139.2
	Cu. ft. per min.	2380	2431	2481	2530	2578	2626	2673	2718	2763	2808
	Revolutions	194	198	202	206	210	214	218	221	225	229
36"	Horse Power	122.1	130.2	138.4	146.8	155.4	164.1	173.0	182.0	191.1	200.5
	Cu. ft. per min.	3427	3501	3573	3643	3714	3781	3849	3915	3979	4042
	Revolutions	163	167	170	173	176	179	182	185	188	191
42"	Horse Power	174.7	186.2	197.9	210.0	222.2	234.6	247.3	260.3	273.3	286.7
	Cu. ft. per min.	4900	5007	5109	5211	5310	5407	5503	5598	5689	5781
	Revolutions	139	142	145	148	151	154	156	158	161	164
48"	Horse Power	226.0	240.9	256.1	271.6	287.5	303.6	320.0	336.7	353.4	370.9
	Cu. ft. per min.	6340	6477	6610	6741	6870	6996	7120	7242	7362	7479
	Revolutions	122	125	128	130	132	134	136	138	141	143

Power Table For Fitz-Burnham Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		33	34	35	36	37	38	39	40	41	42
9"	Horse Power	9.88	10.34	10.79	11.24	11.71	12.17	12.64	13.11	13.60	14.10
	Cu. ft. per min.	192	195	198	201	204	207	209	211	214	217
	Revolutions	776	788	799	810	821	832	843	854	864	875
10½"	Horse Power	13.44	14.06	14.67	15.30	15.93	16.56	17.19	17.85	18.51	19.20
	Cu. ft. per min.	264	268	272	276	279	282	285	288	291	294
	Revolutions	664	674	684	694	704	714	723	732	741	750
12"	Horse Power	18.65	19.51	20.38	21.26	22.15	23.10	23.93	24.84	25.63	26.54
	Cu. ft. per min.	364	370	376	381	386	391	396	400	405	410
	Revolutions	582	591	600	608	616	624	632	640	648	656
13½"	Horse Power	23.62	24.69	25.77	26.88	28.01	29.16	30.32	31.48	32.60	33.80
	Cu. ft. per min.	461	468	476	483	489	496	501	507	514	520
	Revolutions	517	525	533	541	548	555	562	569	576	583
15"	Horse Power	32.80	34.29	35.81	37.36	38.94	40.55	42.18	43.82	45.45	47.10
	Cu. ft. per min.	641	652	661	670	679	688	696	705	714	723
	Revolutions	465	472	479	486	493	500	506	512	519	525
16½"	Horse Power	39.69	41.53	43.38	45.23	47.13	49.05	51.00	52.98	55.28	57.32
	Cu. ft. per min.	776	788	800	811	822	833	843	854	867	879
	Revolutions	424	430	436	442	448	454	460	466	472	478
18"	Horse Power	52.48	54.85	57.28	59.76	62.28	64.84	67.43	70.02	72.56	75.24
	Cu. ft. per min.	1026	1041	1056	1071	1086	1101	1116	1130	1144	1160
	Revolutions	388	394	400	406	412	417	422	427	432	437
21"	Horse Power	71.43	74.70	78.04	81.40	84.82	88.26	91.75	95.32		
	Cu. ft. per min.	1396	1417	1438	1459	1479	1499	1518	1537		
	Revolutions	332	337	342	347	352	357	362	366		
24"	Horse Power	93.22	97.47	101.8	106.2	110.7	115.2	119.7	124.4		
	Cu. ft. per min.	1823	1850	1877	1904	1930	1956	1982	2007		
	Revolutions	292	296	300	304	308	312	316	320		
27"	Horse Power	118.0	123.5	129.0	134.5	140.2	145.9	151.7	157.6		
	Cu. ft. per min.	2309	2344	2379	2412	2445	2478	2511	2542		
	Revolutions	258	262	266	270	274	278	281	284		
30"	Horse Power	145.7	152.4	159.2	166.0	173.0	180.1	187.3	194.5		
	Cu. ft. per min.	2851	2893	2935	2977	3018	3059	3099	3138		
	Revolutions	233	237	241	244	247	250	253	256		
36"	Horse Power	210.0	219.6	229.3	239.2	249.3	259.5	269.7	280.2		
	Cu. ft. per min.	4105	4167	4228	4288	4347	4405	4462	4519		
	Revolutions	194	197	200	203	206	209	211	213		
42"	Horse Power	300.3	314.0	328.0	342.1	356.4	371.0	385.8	400.7		
	Cu. ft. per min.	5871	5959	6046	6132	6216	6300	6382	6463		
	Revolutions	167	170	172	174	176	178	180	182		
48"	Horse Power	388.5	406.2	424.2	442.5	461.1	480.0	499.0	519.3		
	Cu. ft. per min.	7594	7708	7821	7932	8041	8149	8256	8361		
	Revolutions	146	148	150	152	154	156	158	160		

Power Table For Fitz-Burnham Turbines

Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		43	44	45	46	47	48	49	50	51	52
9"	Horse Power	14.63	15.15	15.69	16.22	16.75	17.29	17.83	18.39	18.94	19.49
	Cu. ft. per min.	220	223	225	227	229	231	234	236	239	241
	Revolutions	885	895	905	915	925	935	945	955	964	974
10½"	Horse Power	19.90	20.61	21.32	22.04	22.77	23.51	24.25	25.00	25.75	26.50
	Cu. ft. per min.	298	302	306	309	313	316	319	322	325	328
	Revolutions	759	768	777	786	794	802	810	818	826	834
12"	Horse Power	27.50	28.46	29.47	30.48	31.51	32.49	33.49	34.60	35.66	36.72
	Cu. ft. per min.	415	420	424	429	434	439	444	448	452	457
	Revolutions	664	672	680	687	694	701	708	715	723	730
13½"	Horse Power	35.04	36.30	37.58	38.88	40.17	41.47	42.75	44.08	45.39	46.72
	Cu. ft. per min.	527	532	538	544	549	555	560	565	570	576
	Revolutions	590	597	604	611	618	625	631	637	644	651
15"	Horse Power	48.78	50.49	52.23	54.00	55.77	57.55	59.34	61.14	62.94	64.76
	Cu. ft. per min.	732	741	749	757	765	774	782	790	798	806
	Revolutions	531	537	543	549	555	561	567	572	578	584
16½"	Horse Power	59.40	61.51	63.68	65.84	68.00	70.20	72.38	74.61	76.50	78.72
	Cu. ft. per min.	891	900	909	919	928	938	947	956	966	976
	Revolutions	483	489	494	500	505	511	516	521	527	533
18"	Horse Power	78.00	80.80	83.68	86.52	89.36	92.24	95.12	98.08	101.0	103.9
	Cu. ft. per min.	1176	1188	1200	1212	1224	1236	1248	1260	1272	1284
	Revolutions	442	447	452	457	462	467	472	477	482	487

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		53	54	55	56	57	58	59	60	61	62
9"	Horse Power	20.05	20.61	21.19	21.78	22.36	22.95	23.53	24.12	24.68	25.29
	Cu. ft. per min.	243	246	248	250	252	255	257	259	261	263
	Revolutions	983	992	1001	1010	1019	1028	1037	1046	1055	1064
10½"	Horse Power	27.27	28.04	28.82	29.61	30.40	31.20	32.02	32.85	33.67	34.50
	Cu. ft. per min.	331	334	337	340	343	346	349	352	355	358
	Revolutions	842	850	858	866	874	882	889	896	904	911
12"	Horse Power	37.80	38.88	39.96	41.06	42.96	43.28	44.40	45.55	46.70	47.86
	Cu. ft. per min.	462	467	471	475	479	483	487	491	495	499
	Revolutions	737	744	751	758	765	772	778	784	790	797
13½"	Horse Power	48.06	49.41	50.80	52.20	53.60	55.00	56.40	57.81	59.20	60.64
	Cu. ft. per min.	583	588	594	600	605	611	616	620	625	631
	Revolutions	657	663	669	675	681	687	693	698	704	710
15"	Horse Power	66.60	68.48	70.38	72.32	74.19	76.27	78.30	80.35	82.18	84.56
	Cu. ft. per min.	813	820	828	835	842	849	856	864	871	878
	Revolutions	590	596	602	607	612	617	622	627	632	637
16½"	Horse Power	81.00	83.27	85.60	87.97	90.27	92.70	95.13	97.56	99.99	102.69
	Cu. ft. per min.	985	994	1003	1012	1021	1030	1039	1048	1057	1066
	Revolutions	539	545	550	555	560	564	568	572	577	582
18"	Horse Power	106.9	109.9	113.0	116.1	119.2	122.3	125.4	128.5	131.6	134.9
	Cu. ft. per min.	1296	1308	1320	1332	1344	1356	1368	1380	1392	1404
	Revolutions	492	497	502	506	510	514	518	522	527	531

Power Table For Fitz-Burnham Turbines

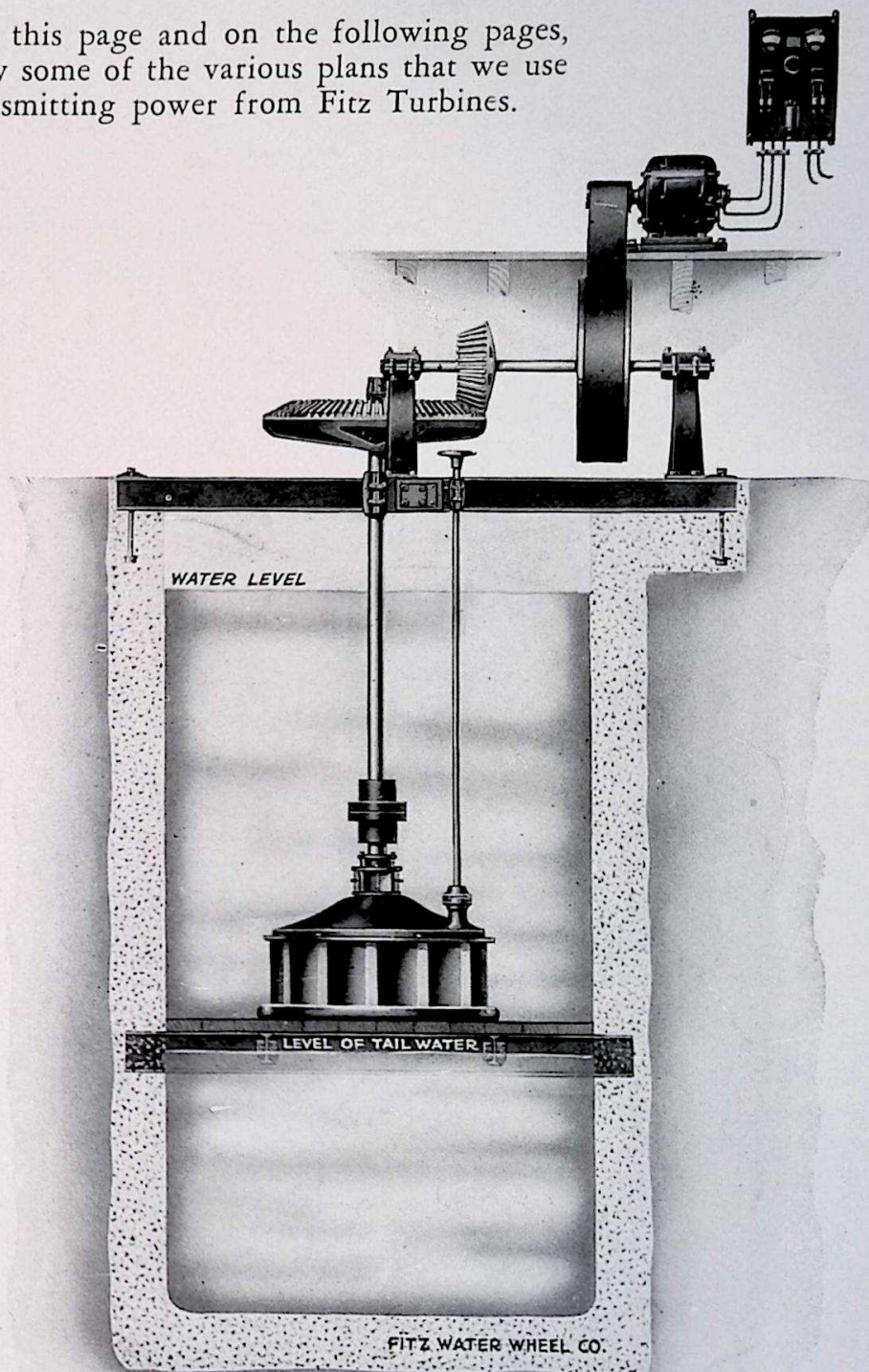
Showing runner diameters of turbines in inches, and horse power produced under various heads of water. Also cubic feet of water used per minute and number of revolutions of turbine shaft per minute under the head specified.

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		63	64	65	66	67	68	69	70	71	72
9"	Horse Power	25.92	26.55	27.20	27.87	28.47	29.09	29.72	30.39	31.07	31.72
	Cu. ft. per min.	265	267	270	272	274	276	279	280	282	284
	Revolutions	1073	1081	1089	1097	1105	1113	1121	1129	1137	1145
10½"	Horse Power	35.34	36.19	37.05	37.92	38.77	39.63	40.50	41.37	42.27	43.07
	Cu. ft. per min.	361	364	367	370	373	376	378	381	383	387
	Revolutions	919	926	933	940	947	954	961	968	975	982
12"	Horse Power	49.02	50.18	51.34	52.50	53.68	54.86	56.05	57.26	58.49	59.74
	Cu. ft. per min.	503	507	511	515	518	521	524	528	532	537
	Revolutions	803	810	816	822	828	835	841	847	853	859
13½"	Horse Power	62.08	63.60	65.20	66.73	68.28	69.81	71.34	72.85	74.44	76.04
	Cu. ft. per min.	638	643	648	652	657	662	667	672	676	681
	Revolutions	716	722	728	734	740	746	752	758	764	770
15"	Horse Power	86.45	88.39	90.27	92.79	94.77	96.75	99.36	101.34	103.41	105.39
	Cu. ft. per min.	885	892	900	907	914	921	927	934	940	946
	Revolutions	643	648	653	658	663	668	673	677	682	687
16½"	Revolutions	105.12	107.64	110.07	112.86	115.90	117.81	120.60	123.30	126.00	128.70
	Cu. ft. per min.	1075	1084	1093	1102	1111	1119	1127	1135	1144	1153
	Horse Power	587	592	596	601	605	610	614	618	622	626
18"	Horse Power	138.3	141.6	145.0	148.3	151.6	155.0	158.5	163.1	165.6	169.2
	Cu. ft. per min.	1416	1428	1439	1450	1461	1472	1483	1494	1504	1514
	Revolutions	535	540	544	548	552	556	560	564	568	572

Size of Turbine		WORKING HEAD OF WATER IN FEET									
		73	74	75	76	77	78	79	80	85	90
9"	Horse Power	32.40	33.07	33.75	34.42	35.10	35.77	36.45	37.12	40.55	44.19
	Cu. ft. per min.	285	288	290	291	293	295	297	299	309	318
	Revolutions	1153	1161	1169	1177	1185	1193	1200	1207	1243	1280
10½"	Horse Power	43.95	44.85	45.75	46.67	47.60	48.54	49.51	50.50	55.25	60.19
	Cu. ft. per min.	390	393	396	398	400	402	405	407	420	432
	Revolutions	989	996	1003	1010	1016	1022	1028	1034	1066	1097
12"	Horse Power	61.00	62.28	63.58	64.89	66.22	67.55	68.88	70.42	77.12	84.00
	Cu. ft. per min.	542	546	550	554	557	560	564	566	586	603
	Revolutions	865	871	877	882	888	894	900	905	932	960
13½"	Horse Power	77.65	79.28	80.88	82.48	84.08	85.68	87.36	88.96	97.80	106.56
	Cu. ft. per min.	686	691	695	699	703	707	711	715	741	764
	Revolutions	775	780	786	791	796	801	807	812	828	853
15"	Horse Power	107.46	109.62	111.78	114.03	116.37	118.80	121.23	123.84	135.42	147.54
	Cu. ft. per min.	951	956	961	967	973	979	984	999	1030	1061
	Revolutions	692	696	701	706	710	715	720	725	746	768
16½"	Horse Power	131.40	134.19	136.89	139.59	142.38	145.26	148.05	151.02	164.34	179.04
	Cu. ft. per min.	1161	1170	1178	1186	1194	1201	1208	1215	1246	1283
	Revolutions	631	635	639	644	648	653	657	661	678	698
18"	Horse Power	172.8	176.4	180.0	183.6	187.2	190.8	194.4	198.0	217.00	236.00
	Cu. ft. per min.	1524	1534	1544	1554	1564	1574	1584	1593	1647	1694
	Revolutions	576	580	584	588	592	596	600	604	622	640

Typical Installation Plans

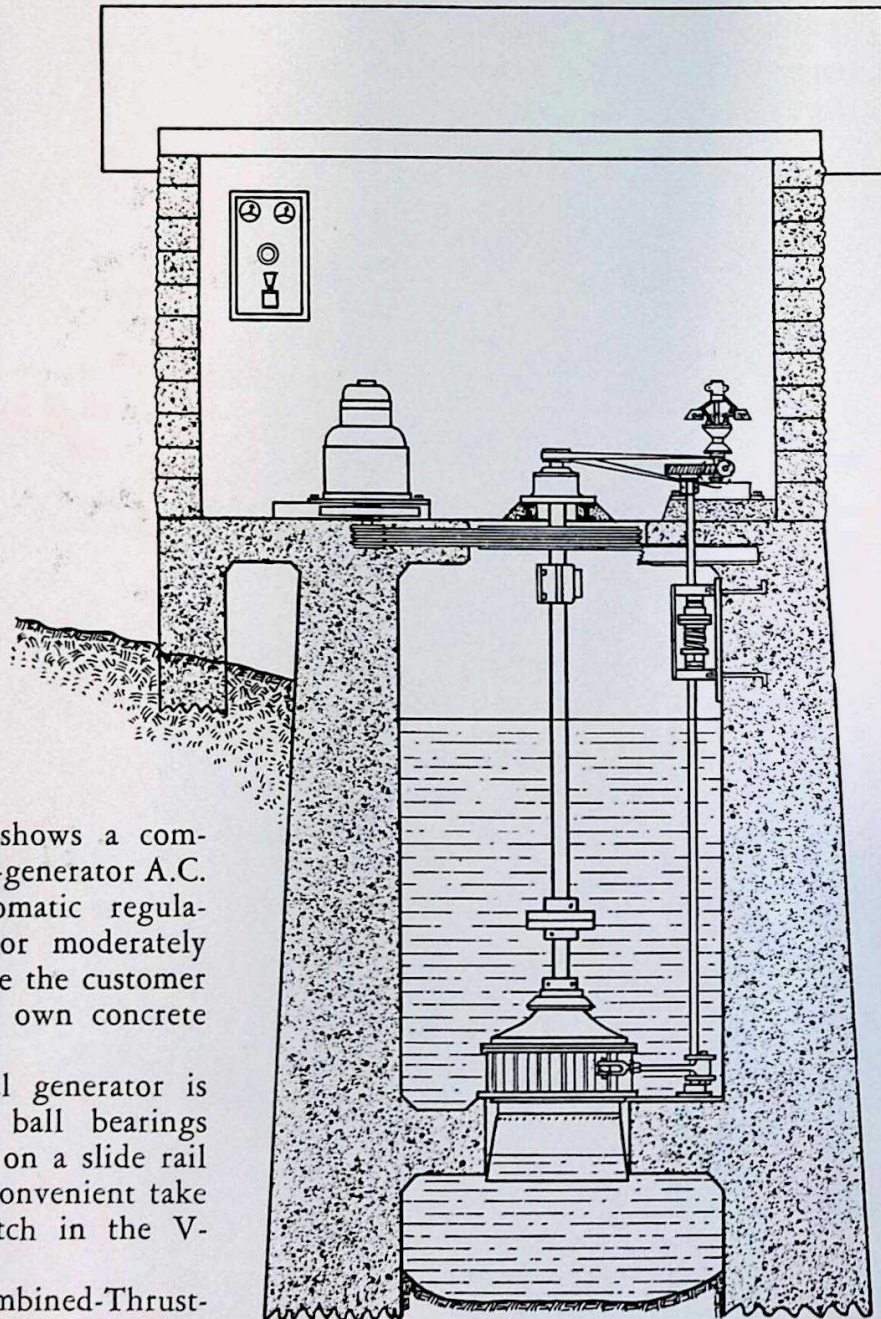
On this page and on the following pages, we show some of the various plans that we use for transmitting power from Fitz Turbines.



Bevel Mortise Gear Drive from Vertical Turbine Mounted in Open Concrete Penstock.

An old but simple and inexpensive plan frequently used for driving flour mills and factories, as well as generators, where the head is low and where the noise from the gearing is not objectionable.

Vertical Fitz Turbine Mounted In Concrete Flume, With V-Belt Drive To Vertical A. C. Generator



This plan shows a complete Fitz Turbo-generator A.C. Unit with automatic regulation; suitable for moderately low heads, where the customer can provide his own concrete flume.

The vertical generator is equipped with ball bearings and is mounted on a slide rail base to permit convenient take up of any stretch in the V-belts.

The Fitz Combined-Thrust-and-Radial Ball Bearing illustrated at the top of the turbine shaft is an advantage that is available only with Fitz Turbines. It is not practical for other makes of turbines that lack the exclusive Fitz features of our suspended type runner and our Micarta sleeve guide in the cover of the turbine.

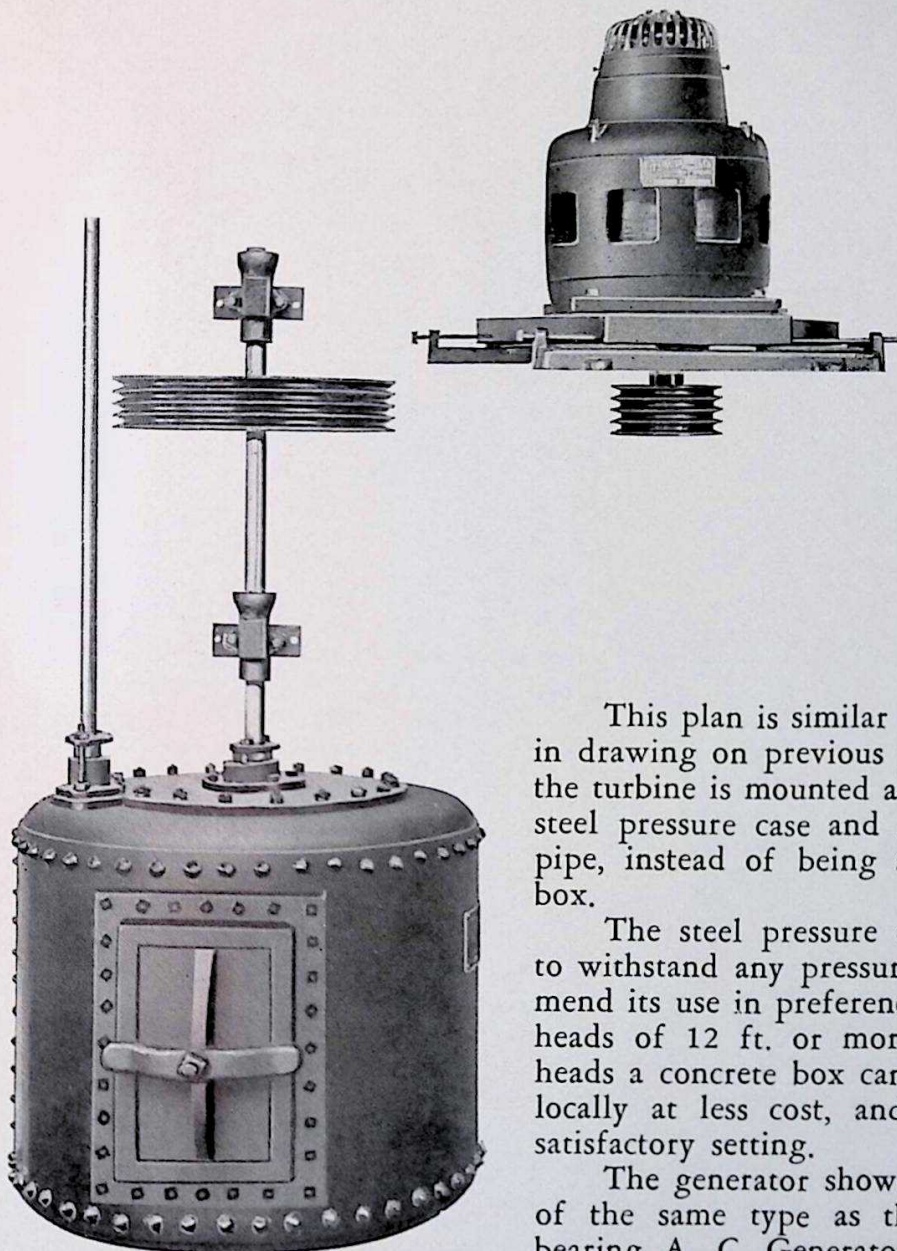
The ball bearing carries the entire rotating weight of the turbine shaft and runner, in addition to the water pressure on the runner. With our ball-thrust bearing there is no pressure on the lignum-vitae thrust block in the turbine, and consequently no chance for sand or grit in the water to cause the thrust block to cut or wear out as it does in other types of turbines when operating under similar conditions.

For ordinary conditions where the water is free from grit and the

pressure is comparatively low, our oil-reservoir type babbitted vertical sleeve bearing will give very satisfactory results and can be furnished at a lower cost.

The Fitz Automatic Water Wheel Governor shown in this drawing, regulates the speed and power automatically by regulating the amount of water used by the turbine. Its use is especially desirable with A. C. plants where close and accurate speed regulation is essential.

Vertical Fitz Turbine Mounted In Steel Pressure Case, With V-Belt Drive To A. C. Generator

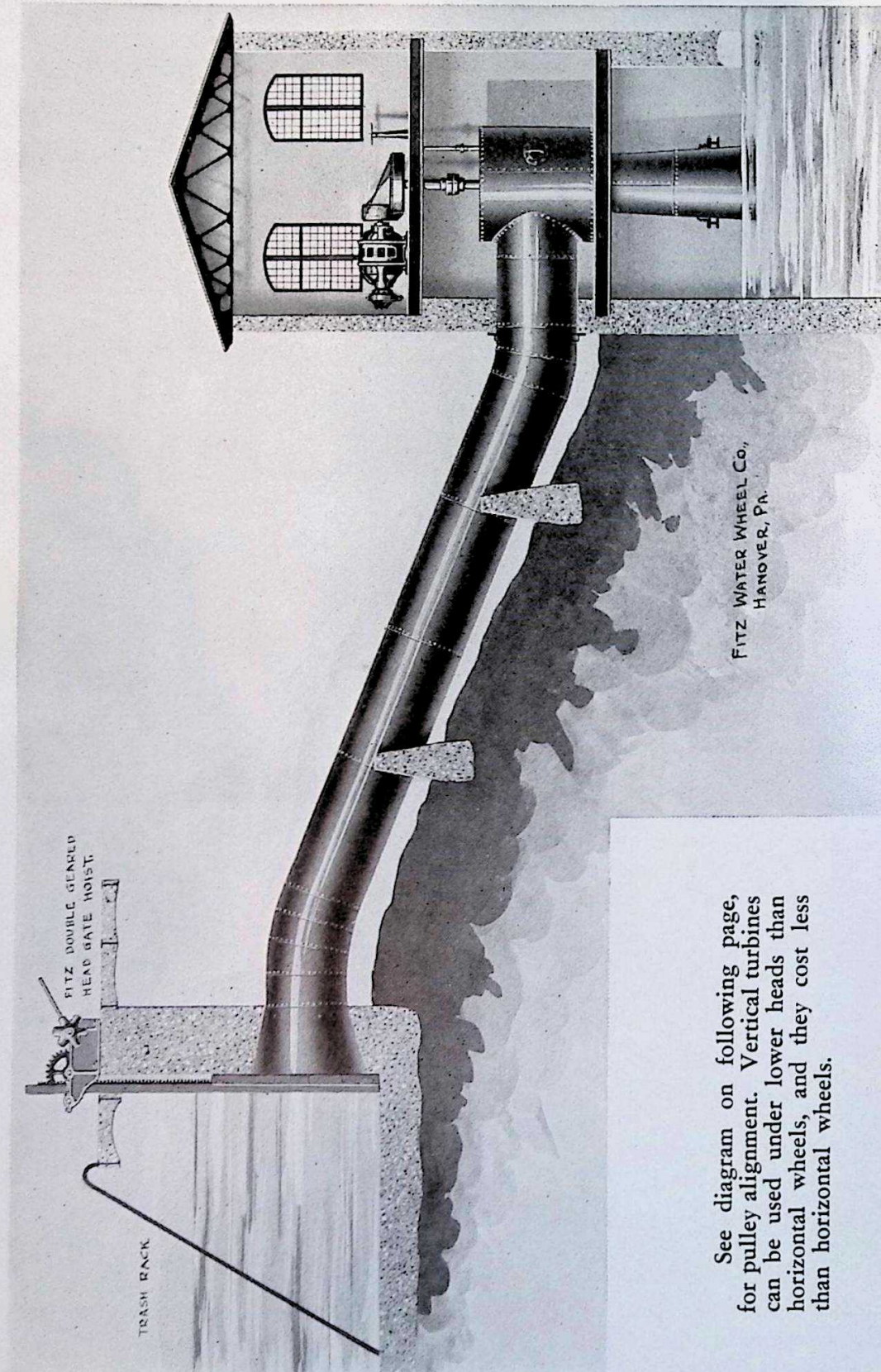


This plan is similar to the one shown in drawing on previous page, except that the turbine is mounted at our factory in a steel pressure case and is fed by a steel pipe, instead of being set in a concrete box.

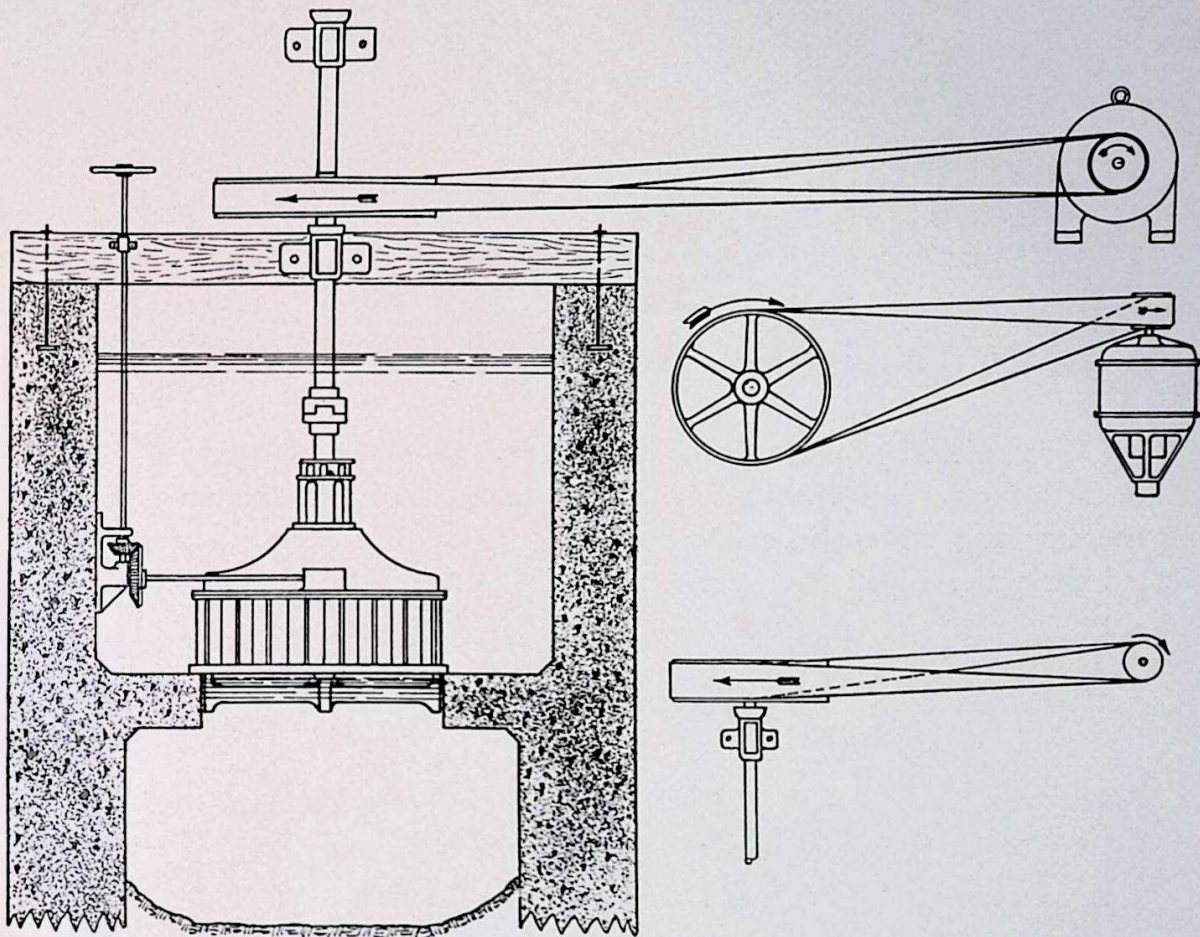
The steel pressure case can be built to withstand any pressure and we recommend its use in preference to concrete for heads of 12 ft. or more. Under lower heads a concrete box can usually be built locally at less cost, and will provide a satisfactory setting.

The generator shown on this page is of the same type as the Vertical ball-bearing A. C. Generator with slide rail base mentioned on previous page. The vertical journal bearing at the top of the turbine shaft is our standard wick-oiling oil reservoir sleeve type. A Fitz Thrust-and-Radial Ball Bearing Box can be supplied instead, at an extra cost, as illustrated on Page 30.

Quarter Twist Belt Drive From Vertical Turbine To Standard Type Horizontal Shaft Generator



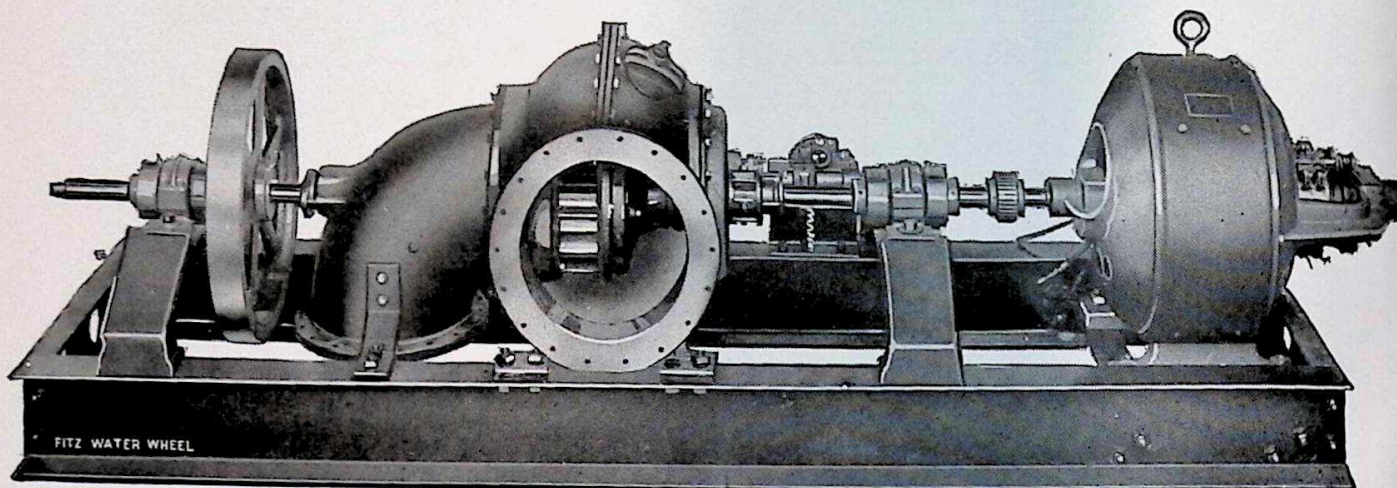
**Quarter-Twist Flat Belt Drive From Vertical Turbine To
Horizontal Line Shaft In Factory Or To Horizontal
Generator Similar To The Transmission
Plan Shown On Page 32.**



In fact, both drives are identical, but the turbine in Page 32 is mounted at the factory in a metal case. The turbine shown in the above drawing is mounted in a wood or concrete penstock.

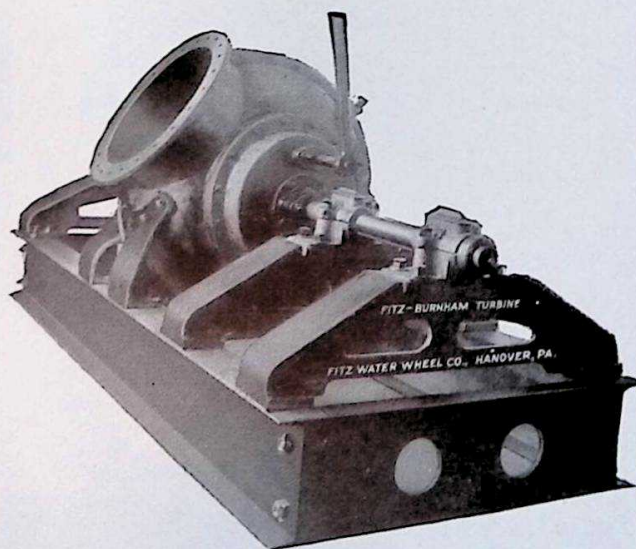
A quarter twist belt drive is the cheapest method of any for transmitting the power from a vertical shaft to a horizontal shaft. It is quite satisfactory in locations where a fairly narrow belt can be used, provided proper care is exercised in aligning the pulleys correctly. The diagram on the right shows how the pulleys should be lined up with each other.

A trash rack and a cut-off gate, as shown on the opposite page, should be installed at the inlet of every turbine flume or penstock.



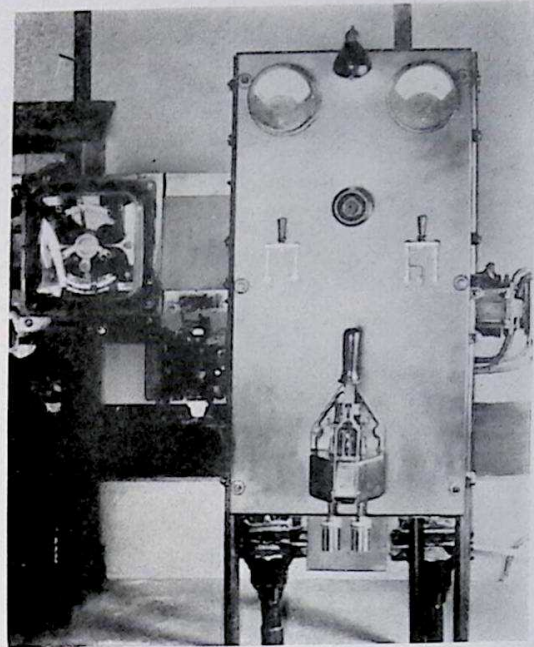
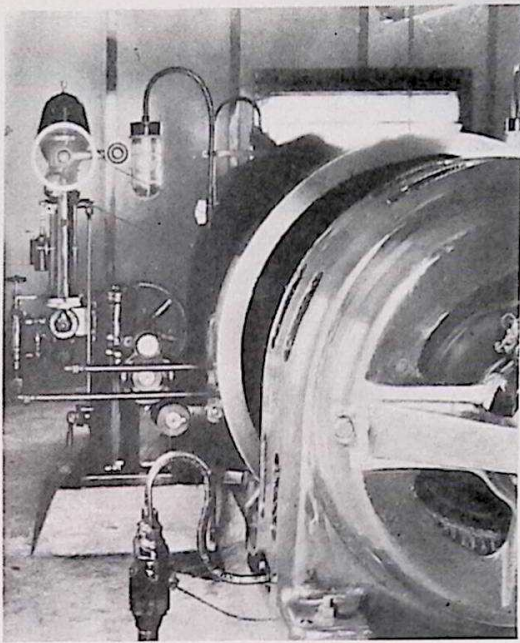
12" horizontal Fitz-Burnham Turbine direct-coupled to General Electric Generator.

A complete hydro-electric unit with a single revolving shaft, mounted at the factory on a heavy I-beam base. We furnish the complete unit, including generator and automatic control, when desired; together with steel pipe to feed the water wheel, head gates, trash rack, etc.



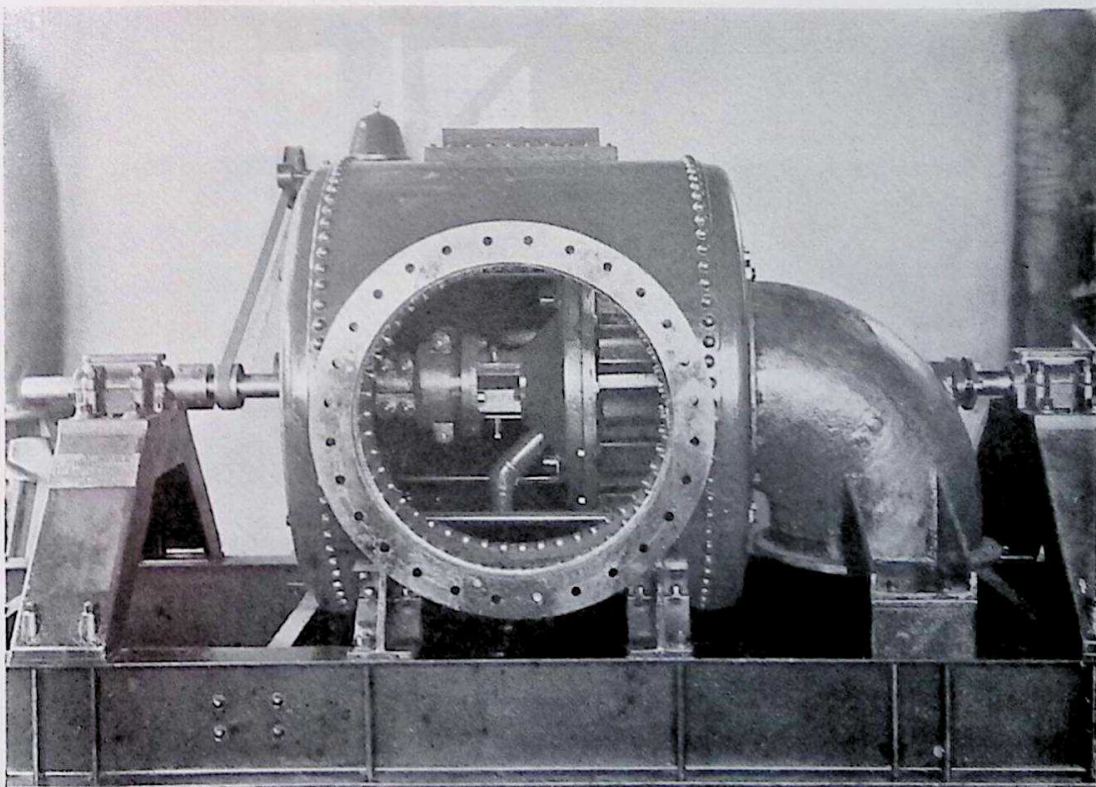
Small horizontal Fitz Turbine for flat belt or V-belt drive.

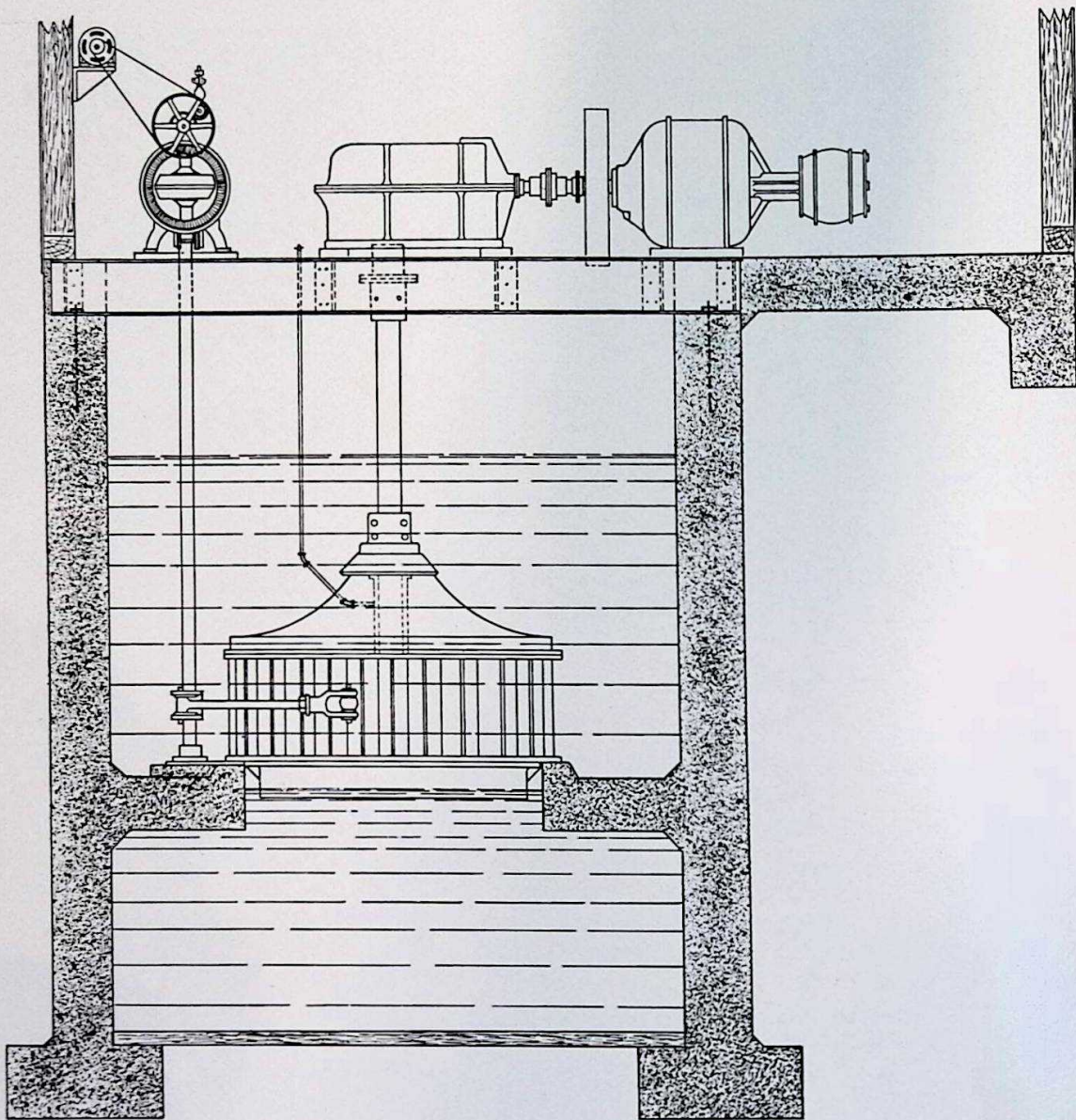
This plan permits the use of a higher speed generator. The inlet to the case can be set at an angle to suit the slope of the feed pipe in any of our horizontal units, thereby saving the cost of a pipe elbow at that point.



Fitz Horizontal Turbine, direct coupled to 150 KVA 2400 volt A. C. Generator.

The illustration in the upper left corner is the view from the generator end of the unit, showing the Automatic Oil-pressure Governor that regulates the speed and power automatically under widely varying loads.





Direct-connected Fitz Hydro Electric Units of the most efficient type can be furnished for many heads that are not practical with other types of turbines.

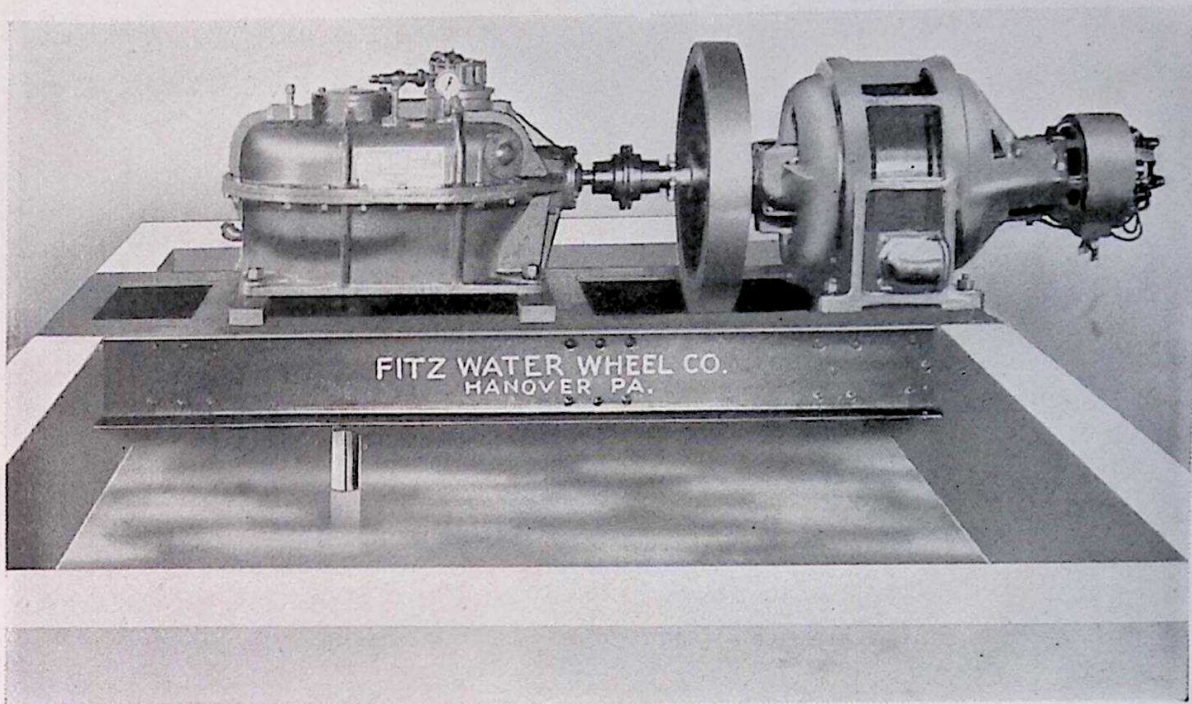
The plan above shows a vertical Fitz-Burnham Turbine operating under a very low head and connected to an A. C. Generator thru a right angle gear box. The generator and gear box are mounted on a heavy steel base frame that spans an open concrete penstock, forming a single unit. The entire rotating weight of the vertical turbine shaft and runner, including the water pressure on the turbine runner, is carried by an over-size ball or roller bearing of ample capacity, at the upper end of the shaft, inside of the gear box.

The gears are of heat treated alloy steel, with machine-cut spiral teeth, running in a bath of oil. The spiral shape of the teeth ensures smooth continuous contact, and complete freedom from shock or vibration.

This is due to the fact that each tooth overlaps the preceding one in meshing, and there is no interval between contact. The bearings are of the Timken Roller type. See photos on following page.

The overall efficiency of a unit like this is the highest obtainable. Only 2% of the power is lost in transmission from the turbine to the generator.

The design of the Burnham turbine permits it to be equipped with rock shaft gate mechanism and with our Micarta guide bearing mounted in a housing cast integral with the dome of the turbine, whenever conditions require.

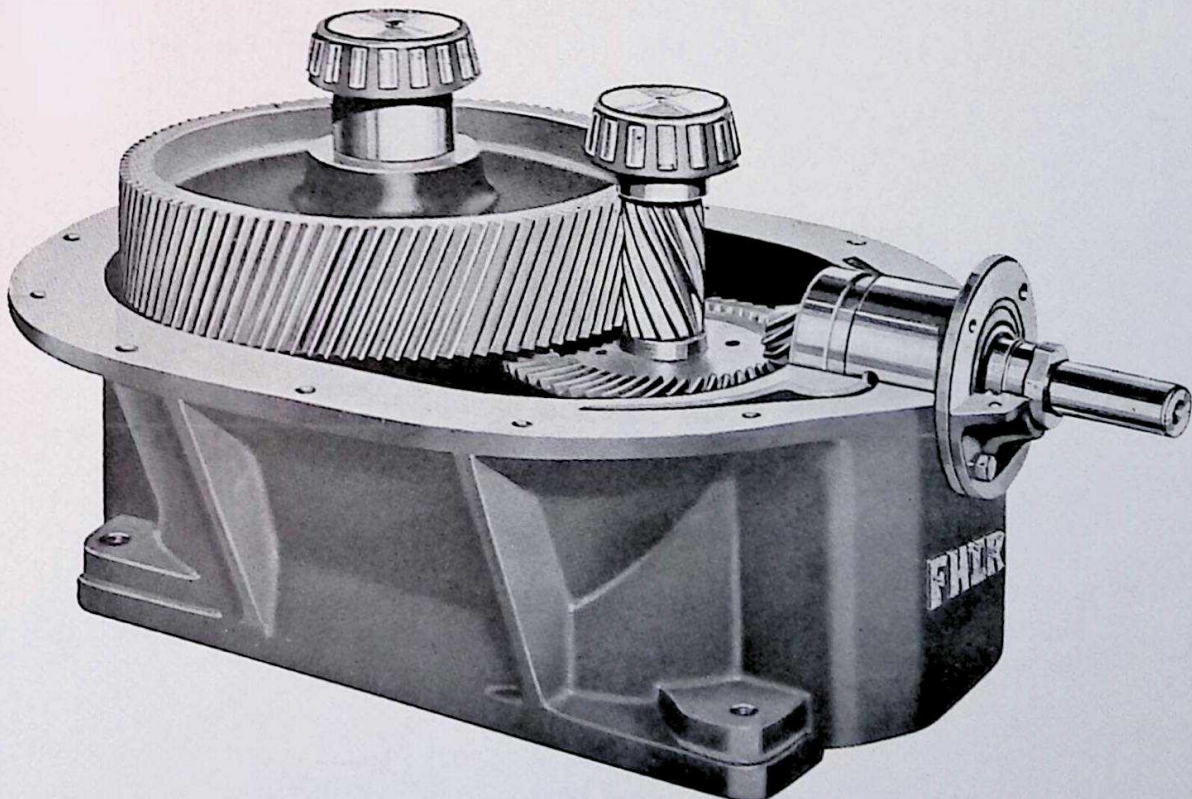


Fitz Turbine direct coupled thru right-angle gear box to A. C. Generator.

This is a unit similar to the one shown in the drawing on the opposite page. This particular photo shows a Fitz-Burnham Turbine installed under 5 ft. working head driving a 15 KVA General Electric Generator at a speed of 1200 RPM.

The special characteristics of the Fitz-Burnham runner enable it to operate efficiently under very low heads and under back-water conditions that would be fatal to the power of any other type of turbine.

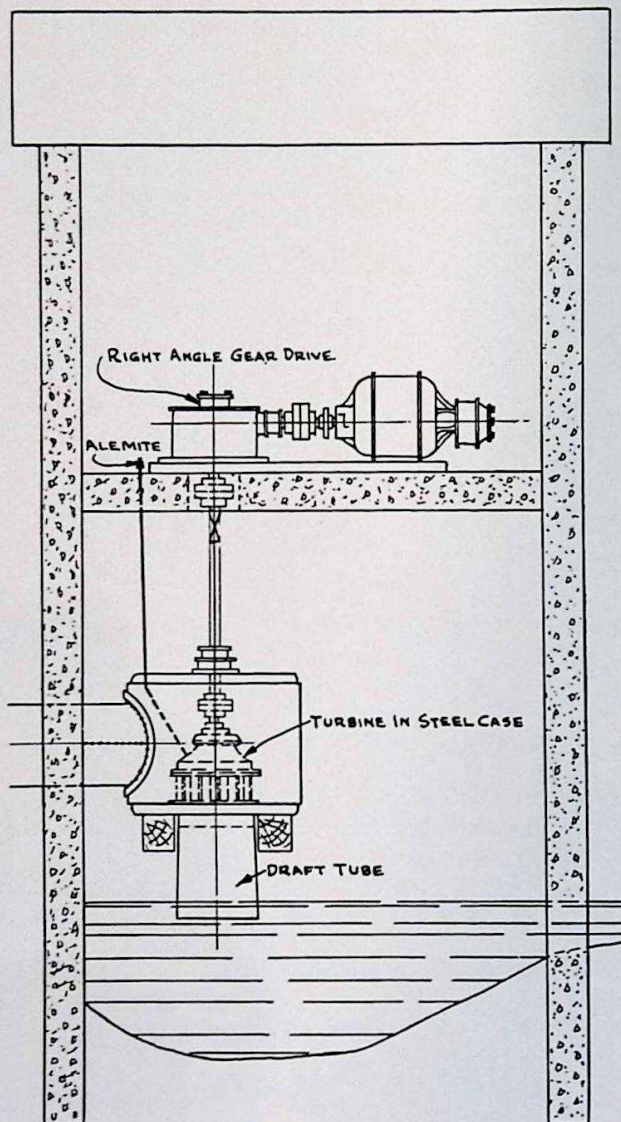
A view of the gear box is shown below with the cover removed. The speed is stepped up to 1200 revolutions with an efficiency of 98%. The extreme accuracy of design and construction required for obtaining such efficiency, ensure quiet operation and freedom from all vibration.



Right Angle Speed Box For Higher Heads

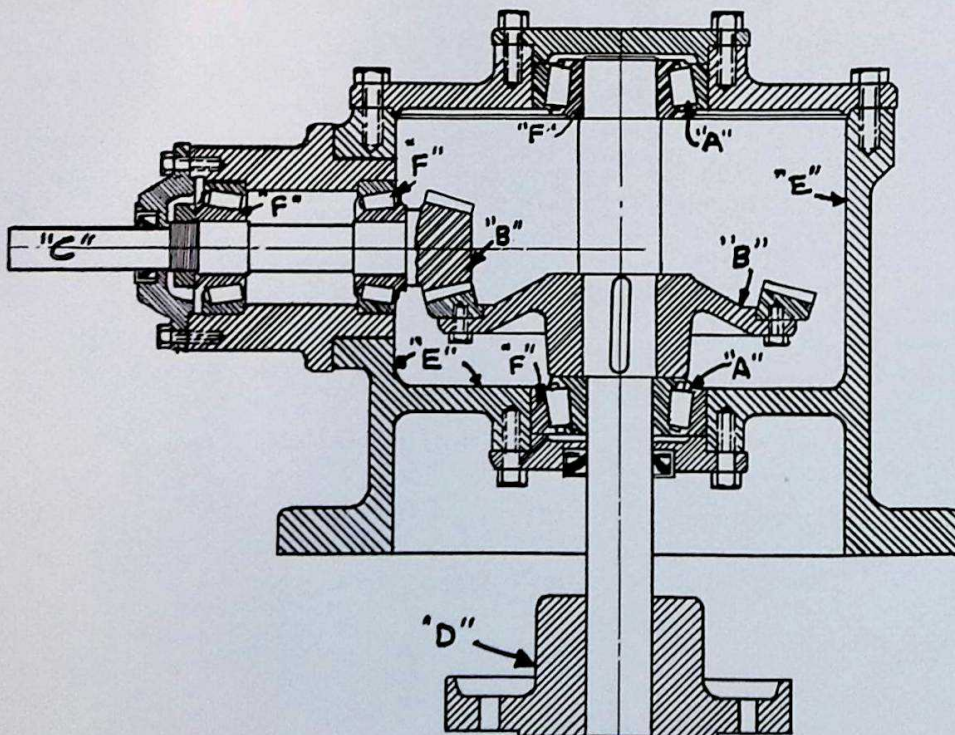
Showing our right angle speed box drive on a higher head where the necessary increase in speed can be obtained with a smaller gear ratio.

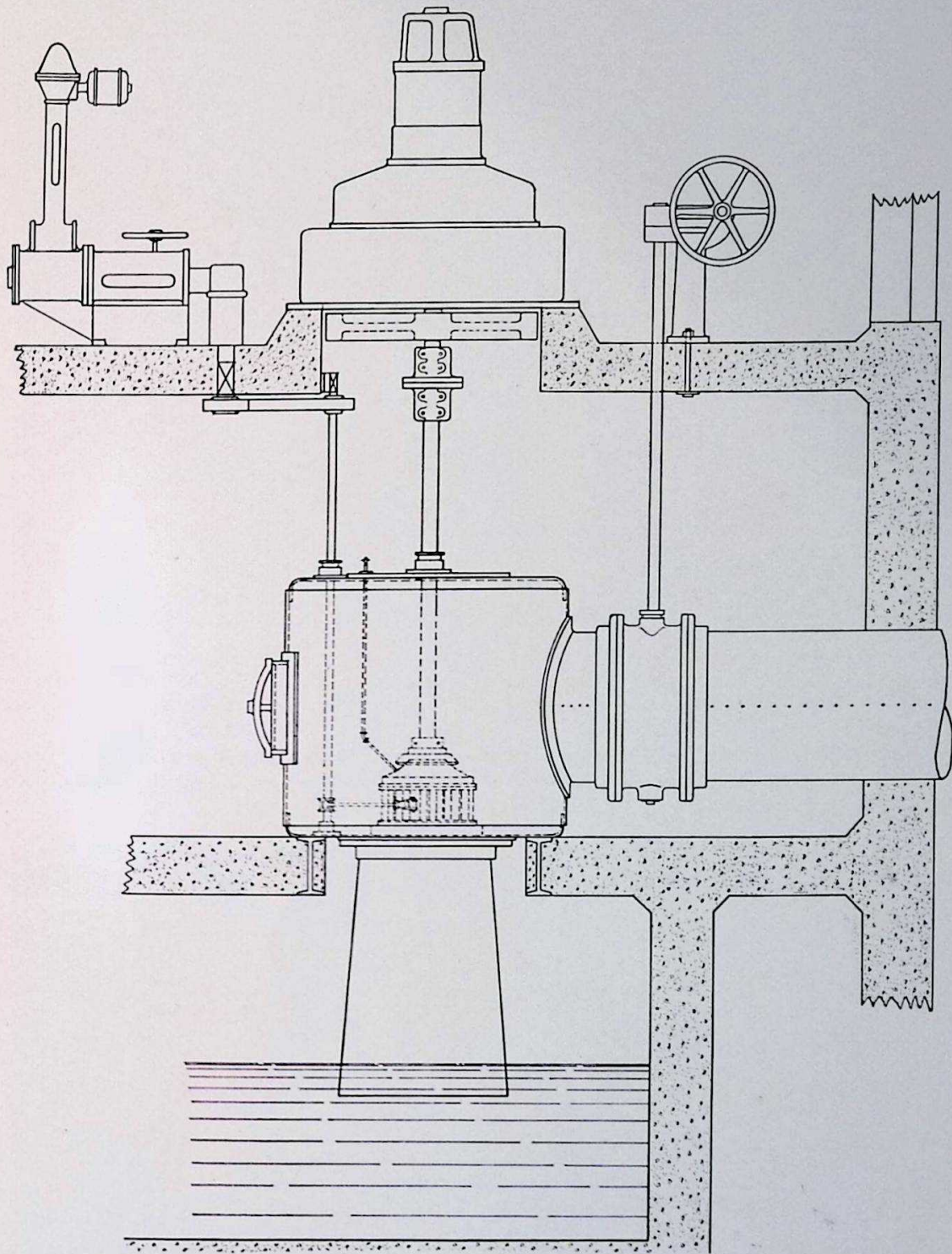
A sectional view of the single-reduction speed box is shown below.



Explanation of Speed-box Drawing

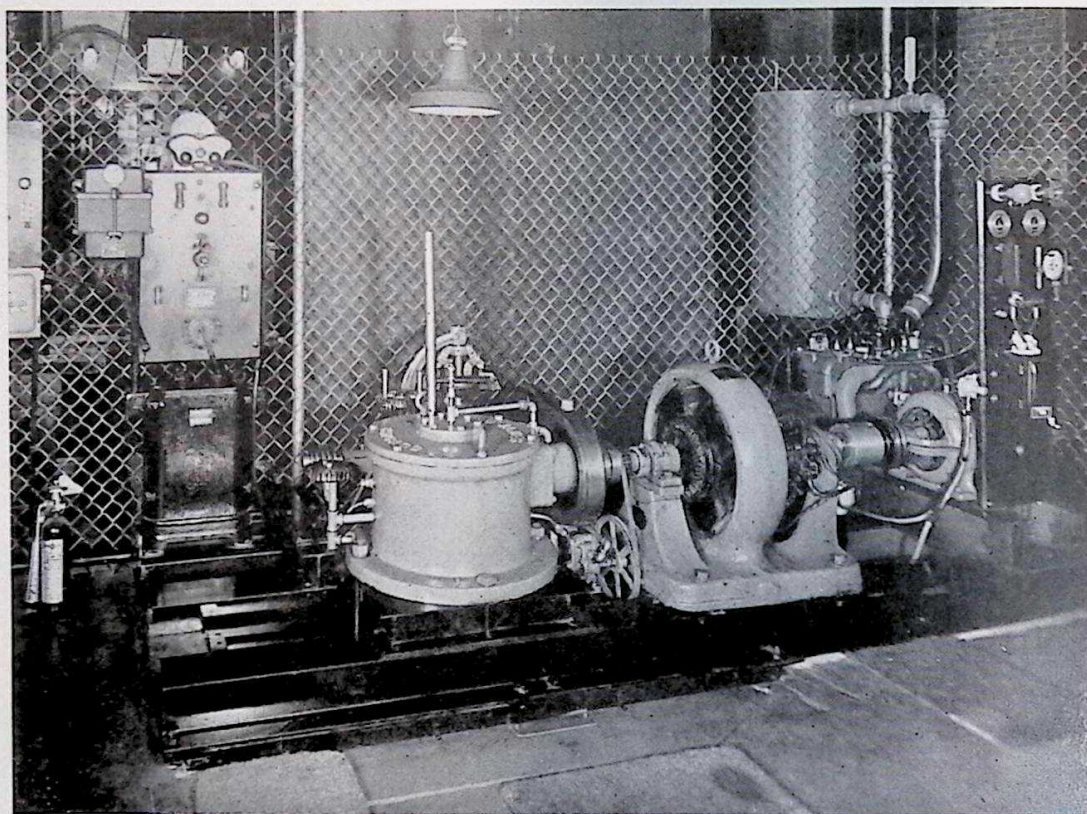
- "A" Roller Bearings of proper capacity to carry weight of water wheel.
- "B" Alloy Steel gears with machine-cut spiral teeth for continuous contact.
- "C" Horizontal speed shaft on roller bearings to be coupled to generator.
- "D" Flanged Coupling pressed on vertical turbine shaft and pinned fast.
- "E" Oil tight case for constant lubrication.
- "F" Timken Roller Bearings.





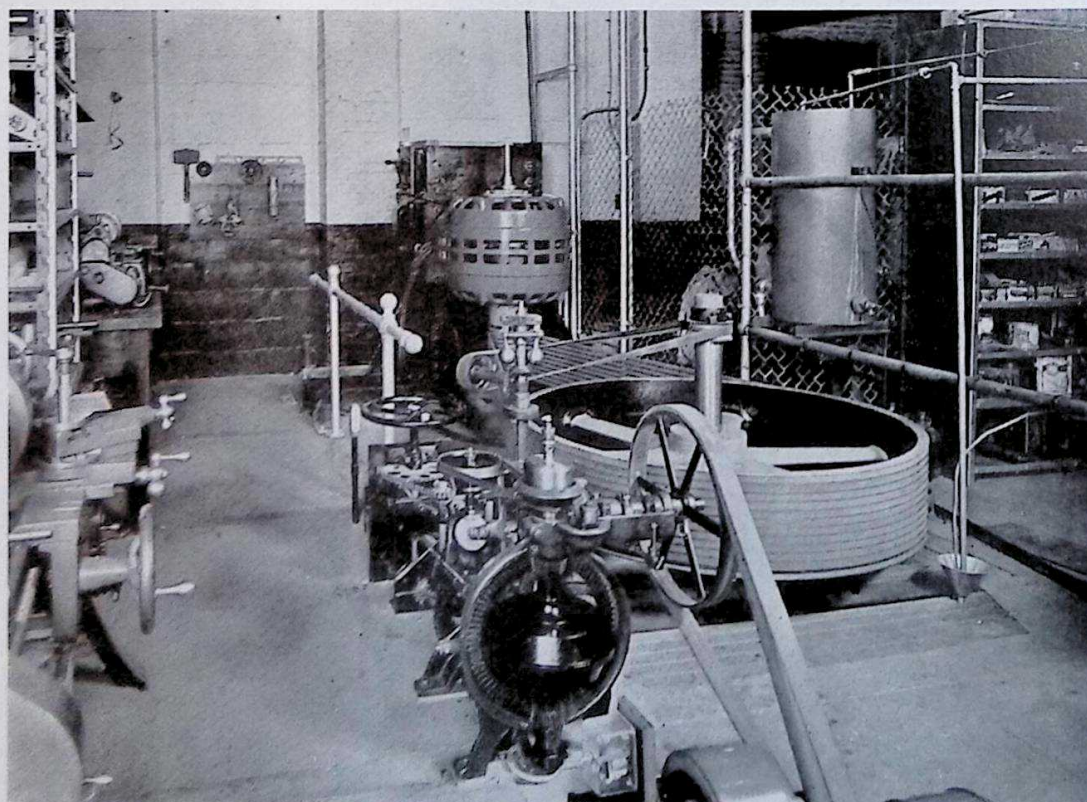
Vertical Turbine Direct-coupled to Umbrella Type Generator.

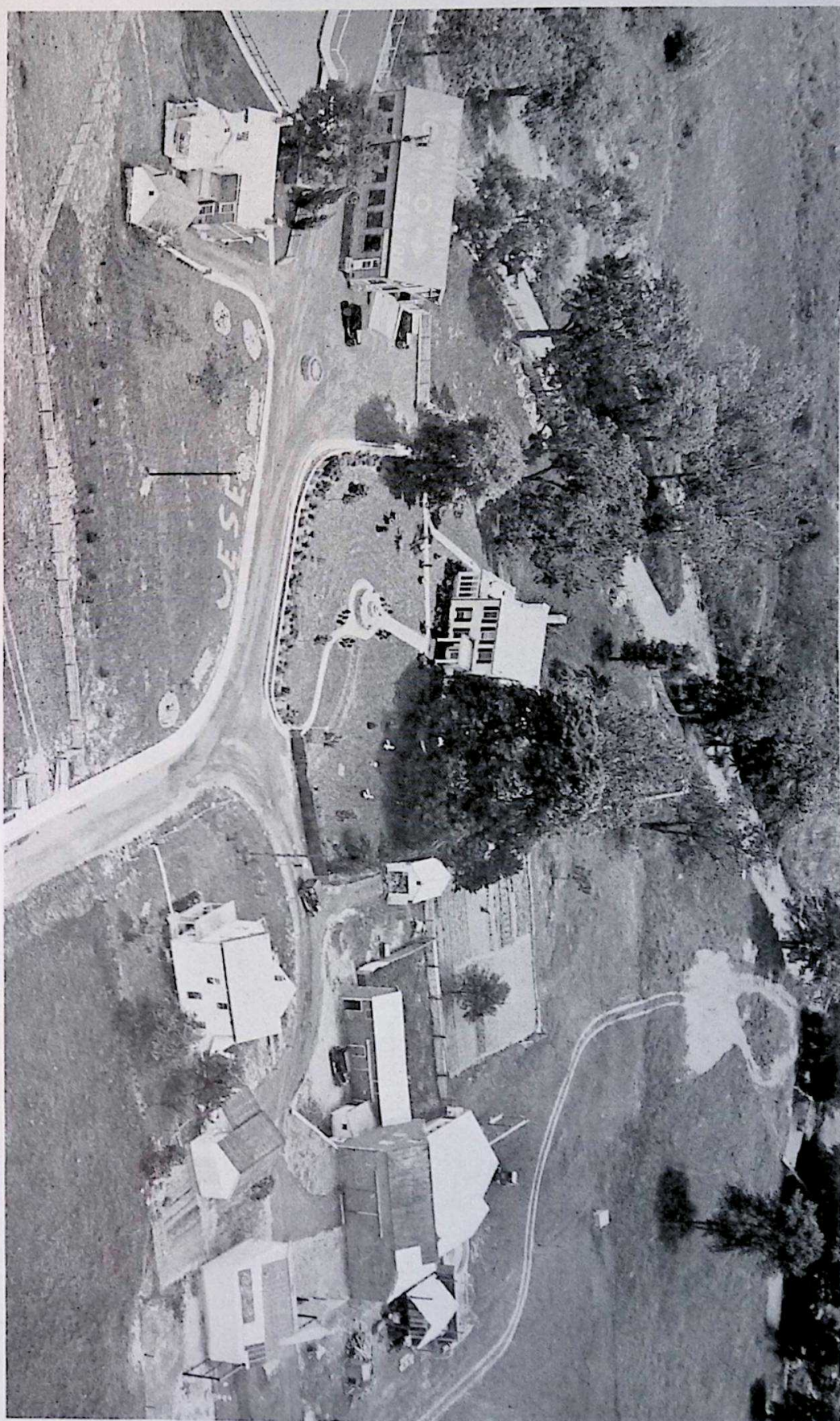
A very good plan for comparatively large units. Seldom desirable for small power plants except where conditions permit fairly high synchronous speeds to be obtained without requiring special designs.



Upper view shows installation of 18" Fitz-Hanover Turbine with Right Angle Speed Box coupled to A. C. Generator, similar to plan on Page 38. The turbine is mounted in steel case below the concrete floor. Fitz Automatic Governor is just back of speed box.

Lower Photo taken in the same power-house, shows 30" Fitz-Hanover driving vertically mounted A. C. Generator, by V-belts. Governor is driven by synchronous motor. Both generators built by General Electric Co.



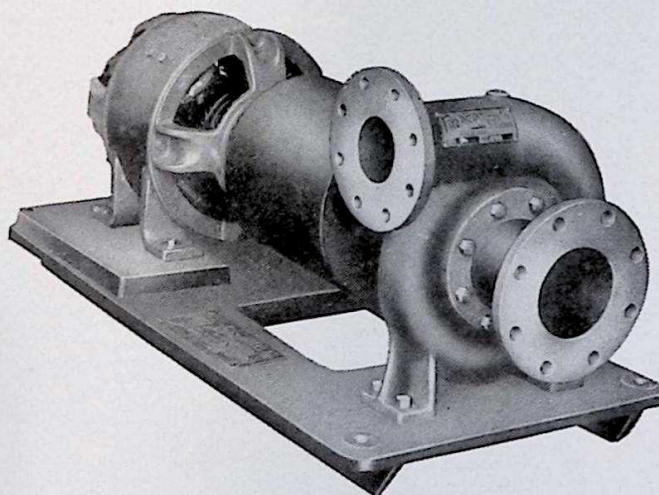


Airplane view of the power house of Mr. Earle S. Eckel, Washington, N. J. in which the two units shown on opposite page are located. The water from the dam flows thru a tube underneath the highway to the two turbines. After passing thru the turbines, the water leaves the power house thru an open ditch or tail race, rejoining the main creek a little farther on. Mr. Eckel's residence is heated thruout by electricity. A very complete air-conditioning system is operated. Cooking-range, water-heating and water supply systems are supplied, besides light and power for the various buildings on the estate, including the airplane hangars, machine shop and research laboratory. All from the power furnished free by the two water wheels.

Fitz Ruralite Turbo-Generator Units

The Fitz Ruralite Unit is a self-contained little Hydro Electric Plant designed for small streams where heads of from 20 ft. to 100 ft. are available. It furnishes 110 volt current D. C. with built-in automatic regulation, and it provides a constant reliable source of light and power for country homes, ranches, hotels, etc.

The smaller sizes of Ruralite Units are frequently operated by flowing wells in localities where wells with good pressure are available. As auxiliary units for furnishing light and power for repairs in Municipal Water Works or factories, in case of failure of their Diesel engines or interruptions of Public Utilities services, they also perform a very valuable service.



Self contained Fitz Ruralite Unit with 2½" dia. Inlet

The Ruralite Unit consists of a Fitz Water Turbine, direct coupled to a suitable electric generator. There are remarkably few parts in it and all are built of the finest materials and workmanship. The runner is of bronze, and it is mounted in a spiral cast iron case, with fixed vanes cast integral with the case. The shaft is of stainless steel.

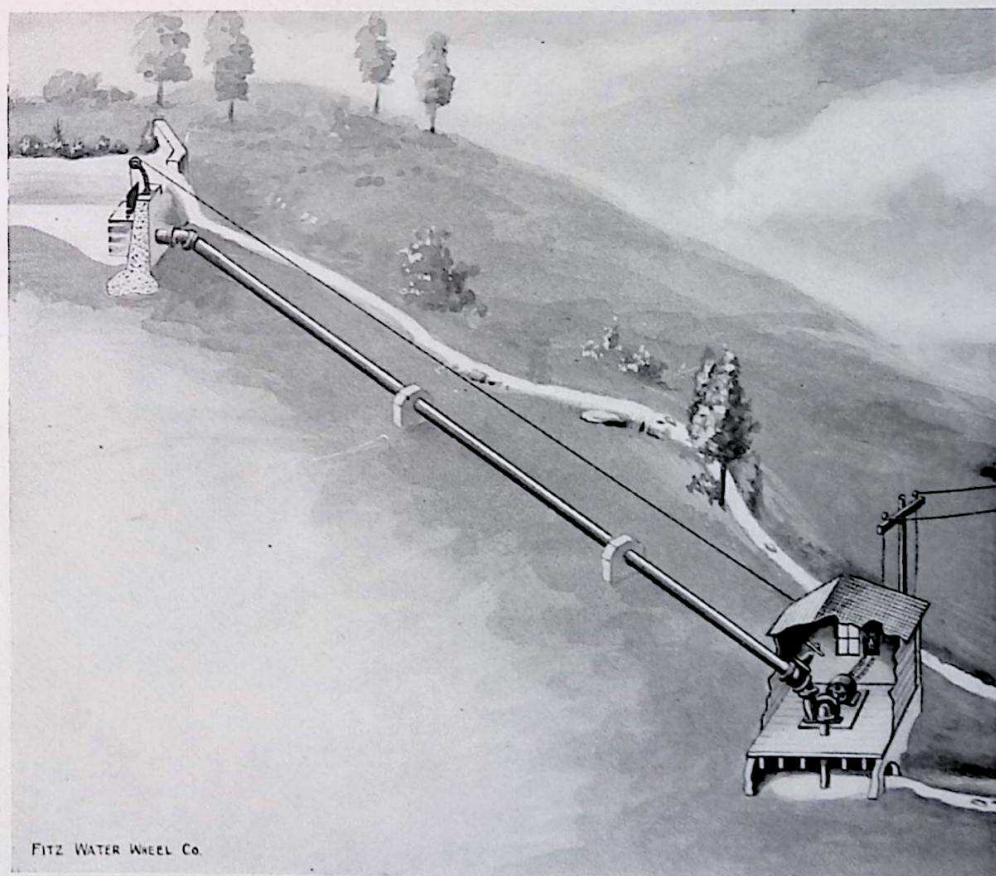
The unit is shipped completely assembled, with the exception of the flanged reducer that bolts to the customer's feed pipe, and the quarter-turn discharge elbow and draft tube. These parts are supplied with the unit, and we also furnish without extra charge, a suitable flanged screen box or cylinder to go at the head of the customer's pipe line. The feed pipe that conveys the water from the dam or well or head race, is not included.

New and very radical engineering improvements make the Fitz Ruralite Plant automatically self governing. No matter what loads are thrown off the plant, the voltage will remain within reasonable limits. In other words, lights may be turned off or on just as desired; toasters and sweepers and refrigerators may be started or stopped as desired; all without requiring any attention or adjustment on the part of the user.

The governing is done by automatically reducing the amount of water supplied to the water wheel. This is the same principle that is used in governing the largest and finest hydro electric plants. The surplus water can accumulate in a dam or storage reservoir, to be used at times of peak loads, instead of being merely diverted and wasted as is done by other types of small turbine governors.

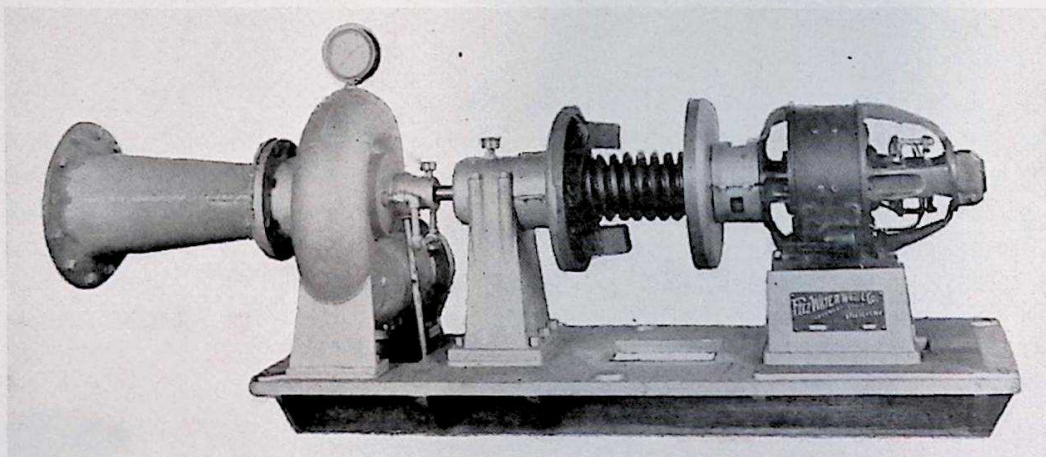
There are many locations where surplus water can not be stored up or accumulated for use in peak load periods; such as when the water is being supplied by a flowing well, or where the slope of the stream bed is too steep to permit the creation of a pond for storage purposes. In such cases we furnish a self-regulated generator in place of the water regulating governor. This is the same type of self regulated generator described elsewhere in this booklet, and it provides the same thoroly dependable and carefree regulation as the water-governor.

The turbines are made in five different sizes of inlet openings, with various types of runners or impellers to suit different conditions. The actual capacity of the plant, of course, depends upon the amount of fall available. Our small-



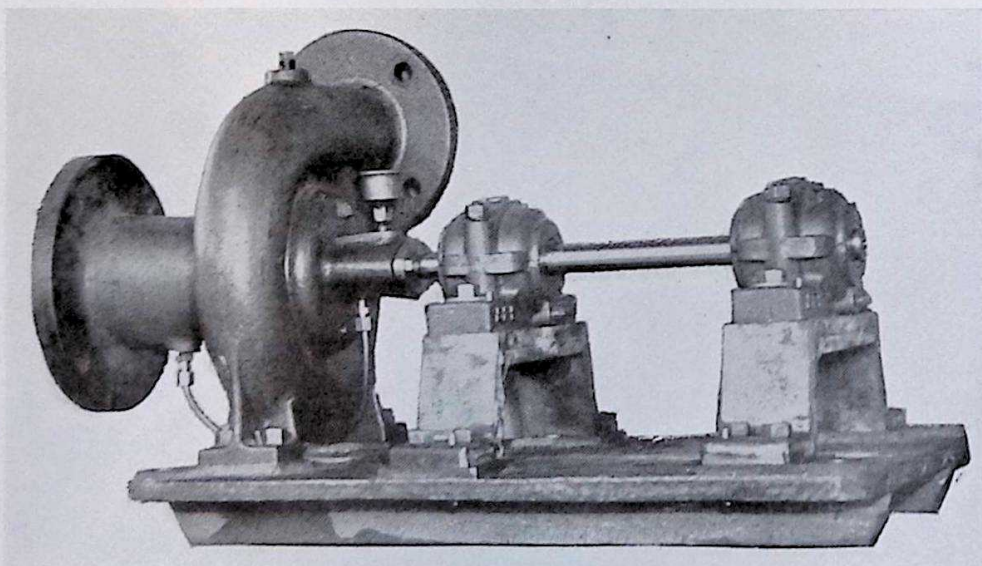
A small pipeline comes down the hill and supplies the FITZ RURALITE with water under pressure, and then the expense is over. No gasoline, coal, or kerosene—all more or less treacherous and dangerous—to buy after the FITZ RURALITE is installed. The plant may be located under a little shed to protect it from the weather, as near or far away from your house as circumstances may require. It will furnish standard 110 volt current D. C. that can be used at considerable distances from the water wheel.

est capacity unit, having an inlet only 2" in diameter, when installed under 40 ft. head, will supply enough current to operate 12 or 13 lamps in the 40 watt size. A Ruralite with an inlet of $2\frac{1}{2}$ " diameter installed under the same head, can operate 30 lamps, while the $3\frac{1}{2}$ " size can operate 60 lamps of 40 watts capacity.



8-A Fitz Ruralite Unit with Actuator Cover Removed.

The 5" and 8" inlet sizes are similar in appearance but differ of course in dimensions. The 2", $2\frac{1}{2}$ " and $3\frac{1}{2}$ " units are made as shown on Page 42. All self-contained Ruralite Units furnish 110 Volt Current, D. C.



Fitz Ruralite Turbine for Belt Drive

Ruralite Turbines in all five sizes can be supplied as shown above, without generator and without speed governing equipment. The horizontal shaft of the turbine is extended to carry a pulley or sheave wheel, and is mounted on ball bearings. The speed can be regulated by means of a gate valve between the turbine inlet and the feed pipe.

This plan is both convenient and economical for those persons who may want to drive an existing generator or pump or other machinery. It permits the Ruralite to be operated under lower or higher heads than are shown in our tables.

Ruralite Power Tables

In the following tables, the volume of water specified in each case represents the amount used by the water wheel when operating at full capacity, under the head specified. These figures represent the cubic feet used per minute.

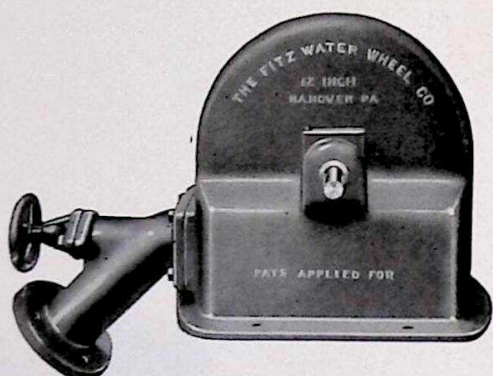
The diameter specified for the feed pipe is the size that should be used, provided the length does not exceed that specified. A larger diameter is required for longer pipes.

		NET EFFECTIVE FALL IN FEET														
		20	25	30	35	40	45	50	55	60	65	70	75	80		
2½" Size	Amount of Water used at full load in cubic ft. per min.	24.9	27.0	28.7	30.4	32.0	33.5	36.0	37.7	39.2	40.7	42.1	43.5			
	Power developed on Water Wheel Shaft, H. P.	.92	1.25	1.53	1.84	2.12	2.40	2.83	3.35	3.85	4.29	4.75	5.25			
	Output in Kilowatts	.500	.72	.90	1.10	1.28	1.45	1.71	2.02	2.32	2.59	2.87	3.16			
	Diameter of Feed Pipe — inches	5	5	5	5	6	6	6	6	6	6	6	6	6		
	Maximum Length of Pipe line of Diam. specified	150	180	210	240	270	300	330	360	390	420	450	480			
Ruralite	Additional Head Required for Pipe Friction, ft.	3	4	5	5	3	4	5	5	5	6	7	8	9		
	Length of Draft Tube — feet (Maximum)	6	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	A	A	A	A	A	A	A	C	C	C	C	C	C		
3½" Size	Amount of Water used at full load in cubic ft. per min.	60.6	61.2	62.4	63.6	65.3	67.0	83.2	87.1	90.6	94.1	97.3	100.5			
	Power developed on Water Wheel Shaft, H. P.	1.56	2.58	3.45	4.20	4.90	5.55	6.54	7.75	8.90	9.92	10.97	12.13			
	Output in Kilowatts	.94	1.56	2.08	2.54	2.95	3.35	3.95	4.67	5.36	5.98	6.64	7.30			
	Diameter of Feed Pipe — inches	7	7	7	7	7	7	8	8	8	8	8	8	8		
	Maximum Length of Pipe line of Diam. specified	150	180	210	240	270	300	330	360	390	420	450	480			
Fitz	Additional Head Required for Pipe Friction, ft.	2	3	3	3	4	5	5	6	6	7	7	8			
	Length of Draft Tube — feet (Maximum)	6	6	6	6	7	7	8	8	8	9	9	9			
	Type of Rotor Furnished	A	A	A	A	A	A	C	C	C	C	C	C			
5" Size	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
	Power developed on Water Wheel Shaft, H. P.	4.06	3.12	5.16	6.90	8.40	9.80	11.1	13.8	15.50	17.80	19.9	21.9	24.2		
	Output in Kilowatts	2.44	1.90	3.12	4.16	5.08	5.90	6.70	7.90	9.34	10.7	12.0	13.28	14.60		
	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
	Power developed on Water Wheel Shaft, H. P.	4.06	3.12	5.16	6.90	8.40	9.80	11.1	13.8	15.50	17.80	19.9	21.9	24.2		
	Output in Kilowatts	2.44	1.90	3.12	4.16	5.08	5.90	6.70	7.90	9.34	10.7	12.0	13.28	14.60		
	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
	Power developed on Water Wheel Shaft, H. P.	4.06	3.12	5.16	6.90	8.40	9.80	11.1	13.8	15.50	17.80	19.9	21.9	24.2		
	Output in Kilowatts	2.44	1.90	3.12	4.16	5.08	5.90	6.70	7.90	9.34	10.7	12.0	13.28	14.60		
	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
	Power developed on Water Wheel Shaft, H. P.	4.06	3.12	5.16	6.90	8.40	9.80	11.1	13.8	15.50	17.80	19.9	21.9	24.2		
	Output in Kilowatts	2.44	1.90	3.12	4.16	5.08	5.90	6.70	7.90	9.34	10.7	12.0	13.28	14.60		
	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
	Power developed on Water Wheel Shaft, H. P.	4.06	3.12	5.16	6.90	8.40	9.80	11.1	13.8	15.50	17.80	19.9	21.9	24.2		
	Output in Kilowatts	2.44	1.90	3.12	4.16	5.08	5.90	6.70	7.90	9.34	10.7	12.0	13.28	14.60		
	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
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	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
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	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
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	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
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	Diameter of Feed Pipe — inches	10	10	10	10	10	10	10	12	12	12	12	12	12		
	Maximum Length of Pipe line of Diam. specified	125	150	180	210	240	270	300	330	360	390	420	450	480		
Fitz	Additional Head Required for Pipe Friction, ft.	2	2	2	3	3	3	3	3	3	4	4	5	5		
	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
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	Length of Draft Tube — feet (Maximum)	4	6	6	6	7	7	7	8	8	8	9	9	9		
	Type of Rotor Furnished	B	A	A	A	A	A	C	C	C	C	C	C	C		
Ruralite	Amount of Water used at full load in cubic ft. per min.	132.8	121.2	122	124	126	130	134	166	174	181	188	194	200		
	Power developed on Water Wheel Shaft, H. P.	4.06	3.12	5.16	6.90	8.40										

The 2" Ruralite has a little over ½ the capacity of the 2½" size under the same heads.

Fitz Impulse Wheels

Fitz Impulse Water Wheels are suitable for very small streams where high heads are available. The runner is cast in one solid piece, with no bolts or separate buckets to work loose. The water is applied to the buckets by means of a suitable nozzle, which delivers the water in a smooth compact jet, at a high velocity.



12" Fitz Impulse wheel completely enclosed in metal case and equipped with needle regulating nozzle

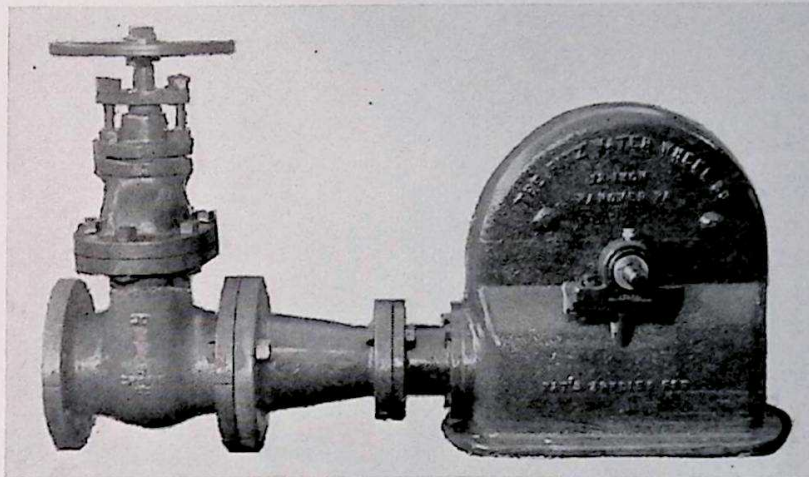
Water wheels of this type are mostly used under heads of from 60 ft. to 500 ft. They can be equipped either with fixed nozzles or with needle regulating nozzles. With a needle type nozzle, the owner can reduce the diameter of the jet by regulating the hand wheel. The "fixed nozzle" is designed to apply a certain fixed or pre-determined volume of water in the most efficient way possible. It has no adjustment feature.

Since a needle regulating nozzle costs many times as much as a fixed nozzle and the adjustment is usually changed only a few times a year, the fixed-nozzle is the type that is most frequently used. What is meant by "fixed-nozzle" is "fixed capacity." A fixed-nozzle can easily be removed in a few minutes and another one of smaller or larger capacity can be installed if desired, if the stream is one that shrinks considerably in dry weather below the volume of water required for normal operation.

Our standard runners, made of semi-steel alloy, are good for heads of up to 350 ft. For higher heads a high tensile bronze is used.

Impulse wheels can be governed automatically by a deflector type governor that deflects a certain part of the jet away from the revolving buckets. The water thus deflected is entirely wasted, but that feature is not objectionable in the majority of impulse installations. Usually, where you can obtain enough fall for an impulse wheel, the slope of the stream bed is too steep to permit much water to accumulate in a storage pond. Consequently the surplus water would be lost anyhow.

Of course, in locations where water to feed the wheel will be drawn from a storage pond or reservoir, a deflector governor would be wasteful of water



Fitz Impulse Wheel equipped with fixed nozzle, flanged reducer, and gate valve.

during low-load periods. In such locations the consumption of water should be regulated by a needle nozzle or by a gate valve mounted just back of a fixed nozzle.

The power and speed of the water wheel can be regulated manually by means of the hand wheel provided with the gate valve or with the needle regulating nozzle. If the power is to be used for generating electricity, the simplest and most satisfactory method of providing automatic regulation is to use the self-regulated D.C. type of generator described elsewhere in this booklet. This eliminates the need for a separate speed governor, and reduces the unit to just two moving parts, the water wheel and the generator.

Power Tables For Fitz Impulse Wheels

1 lb. pressure = 2.31 ft. Head

1 FT. HEAD = .433 lb. per. Sq. In.

Head=Head in Feet H. P.=Horse Power WATER=Cubic Ft. per Min. Speed=Revs. per Min.

Size Wheel	HEAD	20	30	40	50	60	70	80	90	100	110
6"	H. P.	.04	.07	.11	.16	.21	.27	.34	.41	.49	.57
	Water	1.68	1.98	2.28	2.58	2.88	3.12	3.30	3.48	3.72	3.90
	Speed	680	834	960	1075	1180	1272	1361	1442	1522	1595
12"	H. P.	.356	.654	1.07	1.40	1.85	2.33	2.85	3.40	3.98	4.58
	Water	11.76	14.40	16.62	18.60	20.38	22.00	23.50	24.93	26.30	27.60
	Speed	308	378	436	487	534	577	616	654	689	723

Size Wheel	HEAD	120	130	140	150	160	170	180	190	200	210
6"	H. P.	.65	.74	.84	.93	1.04	1.14	1.25	1.35	1.45	1.55
	Water	4.02	4.20	4.38	4.50	4.68	4.80	4.98	5.10	5.22	5.34
	Speed	1668	1733	1800	1860	1922	1983	2040	2095	2150	2200
12"	H. P.	5.21	5.87	6.56	7.26	7.99	8.74	9.53	10.35	11.16	12.03
	Water	28.80	30.00	31.10	32.30	33.25	34.30	35.30	36.20	37.20	38.10
	Speed	755	786	816	844	872	899	925	950	975	1000

Size Wheel	HEAD	220	230	240	250	260	270	280	290	300	350
6"	H. P.	1.65	1.76	1.88	2.01	2.14	2.26	2.38	2.50	2.60	3.32
	Water	5.46	5.58	5.70	5.82	6.00	6.12	6.18	6.24	6.36	6.90
	Speed	2260	2310	2360	2410	2450	2500	2540	2590	2640	2850
12"	H. P.	12.89	13.79	14.69	15.62	16.57	17.52	18.51	19.50	20.52	25.86
	Water	39.00	39.90	40.75	41.55	42.40	43.20	44.00	44.75	45.55	49.20
	Speed	1022	1045	1067	1090	1110	1132	1152	1173	1194	1290



18 Ft. Fitz Overshoot Water Wheel built for Mr. Henry Ford
at Wayside Inn, near South Sudbury, Mass.



16 Ft. Fitz Overshoot driving the well known Soy Bean Plant
of Ford Motor Co. at Tecumseh, Michigan.

Another Fitz Overshoot (see illustration Page 2) has been installed by Ford Motor Co. in their V-8 Valve Plant at Northville, Michigan.

Fitz Overshoots run in the coldest climates. No amount of leaves, sticks, sand, or eels can choke them. Their efficiency is the highest, and they maintain that high efficiency undiminished from full capacity down to one-tenth capacity.

The only overshoot that can be automatically governed.

Fitz Steel Overshoot Water Wheels

For any location where both the fall and the volume of water are within its range, the Fitz Steel Overshoot possesses certain decided advantages over all other types of water wheels or turbines.

Its efficiency is the highest of any. It will maintain that high efficiency, completely undiminished, with any smaller volume of water, down to one tenth the normal capacity of the wheel. It can not be choked by leaves or sticks, or trash or eels. No amount of sand or grit or gravel in the water can do any injury to it.



Fitz Overshoot on Rolling Rock Farm near Pittsburgh, pumping 50,000 gallons of water per day to an elevation of 450 ft. thru 4000 ft. of pipe

The overshoot wheel derives its power directly from the force of gravity. The illustration above shows the principle upon which it works. The weight of the water admitted to the buckets, loads one side of the wheel, causing it to revolve. The purpose of every type of water wheel is to utilize the weight of falling water and to develop power from it. The Fitz Overshoot does that in the most direct manner, and therefore with the least possible loss.

While the basic principle of the overshoot wheel is exceedingly simple, the design and materials and workmanship must all be pretty nearly 100% correct, in order to obtain the remarkable efficiency and thoroly satisfactory service for which Fitz Overshoots are famous. Overshoot water wheels have been known for centuries but up until the advent of the modern Fitz Steel Overshoot an efficiency of 60% was considered very good. Today, practically all experienced engineers concede an efficiency of 90% or more to this type of water wheel "when properly constructed." "Proper construction," when applied to overshoot water wheels, means "Fitz Construction" for no other overshoot water wheel or small turbine has approached such high efficiency.

Fitz Overshoots are mentioned by name in most modern text books on hydraulics. They form part of the equipment of some of the greatest engineering colleges and universities of the world. They are used by the United States Government, and are specified by leading engineering firms thruout the country for small water power installations where high efficiency and perfect reliability are most essential.

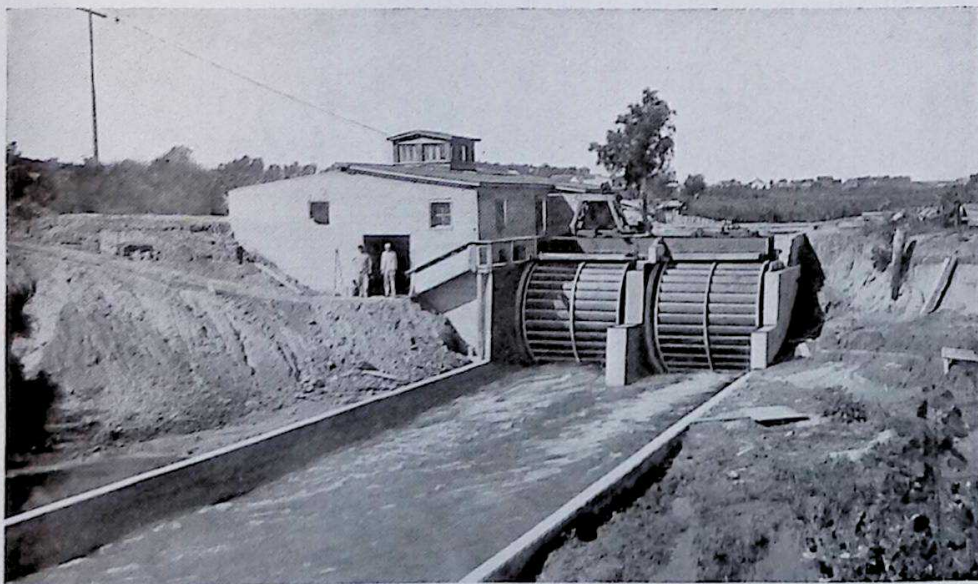
Our wheel is the only overshoot that can be automatically governed. The design of the buckets, their proper spacing, and the accurate construction of the entire wheel, are essential factors in securing satisfactory automatic control. A Fitz Overshoot, equipped with one of our Automatic Water Wheel Governors, provides accurate and dependable regulation, together with maximum economy of water, over a wider range of loads than is possible with any other method.

The field of the overshoot wheel is limited to moderate heads and to comparatively small streams. We build wheels of this type as large as 60 ft. diameter, and we can supply widths sufficient to accomodate up to 3000 cubic feet of water per minute, but these figures represent about the maximum that should be used in single units, except in special circumstances.

No power tables are published for this type of water wheel. Such a great variety of sizes, widths and designs are required for different conditions, that we prefer to recommend the proper wheel in each case after obtaining the necessary data.

An overshoot water wheel costs much more than a turbine of the same capacity, but it is well worth the difference in any location where the fall and water are suitable. A good water power plant is one of the soundest and safest investments a man can make. Its money-earning and money-saving advantages are frequently passed on from generation to generation. The water wheel that will render the best service with the least water is always the cheapest in the long run.

Three generations of constant study and more than a hundred years of unbroken experience in building overshoot water wheels, are responsible for



Twin Fitz Overshoots driving hydro-electric plant in Nebraska. This unit furnishes power for large flour mill in addition to lighting a town three miles away. The plant runs 24 hours per day, and every day in the year.

the really remarkable performance of the Fitz Overshoot. Within its own field it has no real rival. Since our Bulletin No. 70 covers this subject in greater detail we are showing only a few typical overshoot illustrations in this general catalog. Will be glad to send special literature upon request.

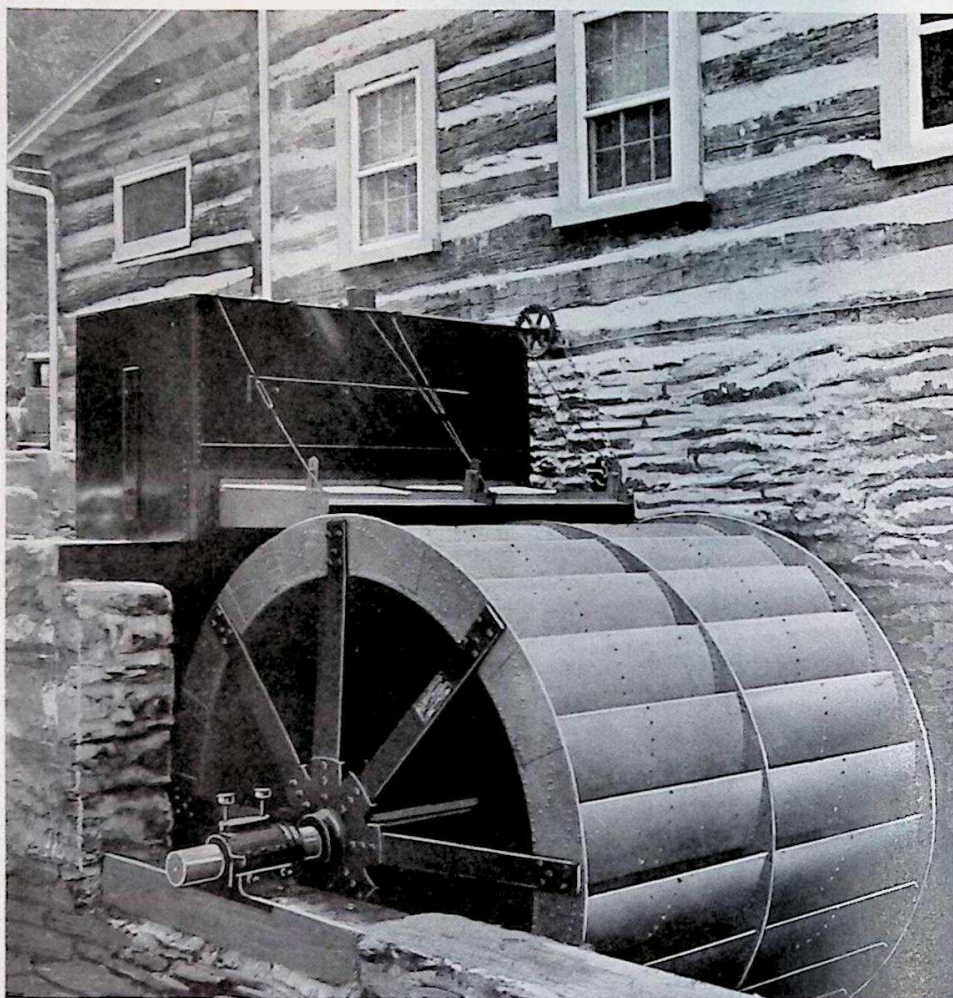


30 ft. dia. by 3½ ft. Fitz Steel Overshoot Water Wheel driving mill of Capt. D. W. Barger, at Shawsville, Va. This wheel is fed by a wooden forebay and is equipped with a segment gear.

Fitz Water Wheels have brought prosperity to water power mills throughout the country for they afford steady power and constant service from streams that would be worthless with any other type of wheel.

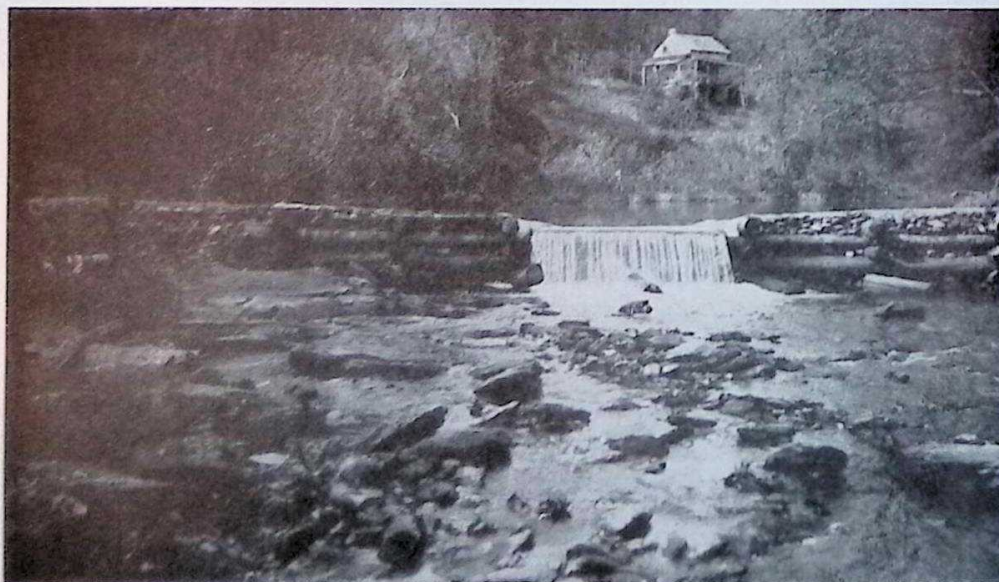
There are more than 900 mills and factories in the State of Virginia alone that are being driven today by Fitz Water Wheels.

Fitz Water Wheels are built for long service as well as for high efficiency and unequalled economy of water at all stages. The first all-metal overshoot built by Samuel Fitz in 1870 is still in operation in Augusta County, Virginia.



An old grist mill, built more than a century ago, has been converted into a modern summer home for Mr. S. Duncan Black of Towson, Md., President of Black & Decker, the world's largest manufacturer of electric drills.

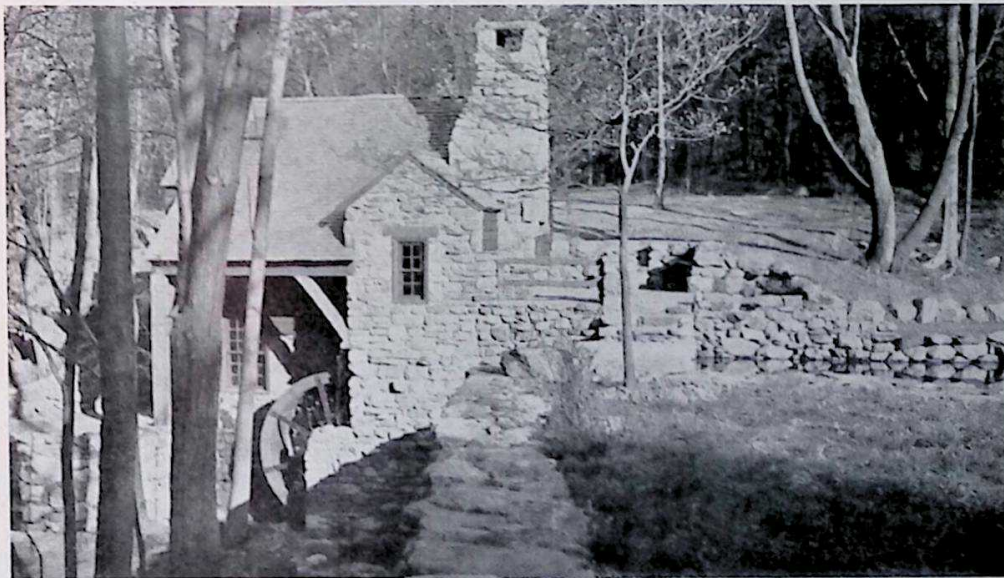
A good water power site never ceases to be a valuable asset. This water wheel drives an A. C. Generator, furnishing an ample supply of electricity for lighting, cooking, refrigeration, etc., for all the buildings on the estate. The gearing is noiseless in operation and the plant is automatically controlled by a Fitz Governor.



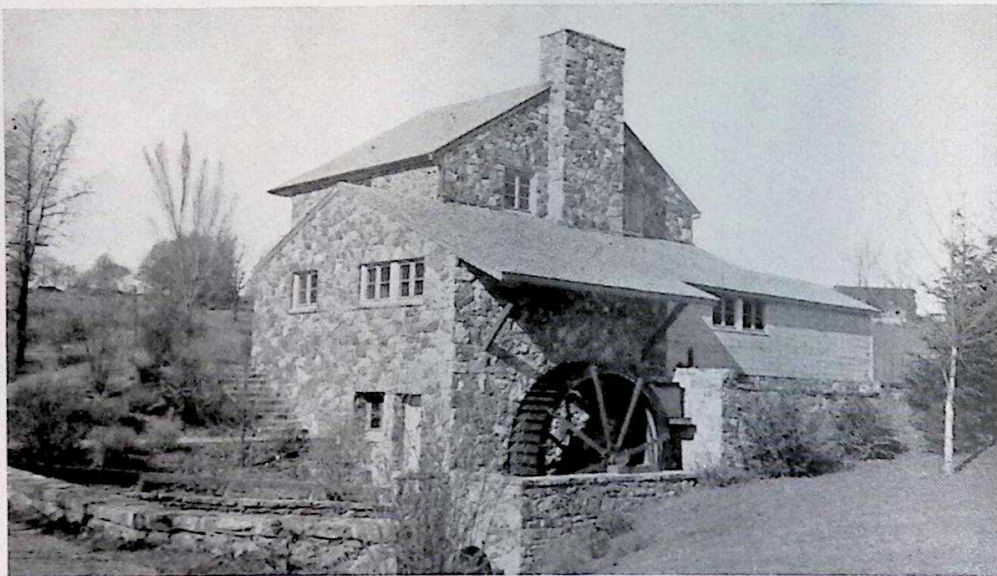
The water to drive the 9 ft. Fitz Overshoot shown above comes from this log dam.



10 ft. Fitz Overshoot driving electric generator for Mr. C. J. Brukner, President of The Waco Aircraft Co. in Ohio. Equipped with automatic regulation.



10 ft. Fitz Overshoot on country estate near Greenwich, Connecticut, driving deep well pump and self regulated generator.

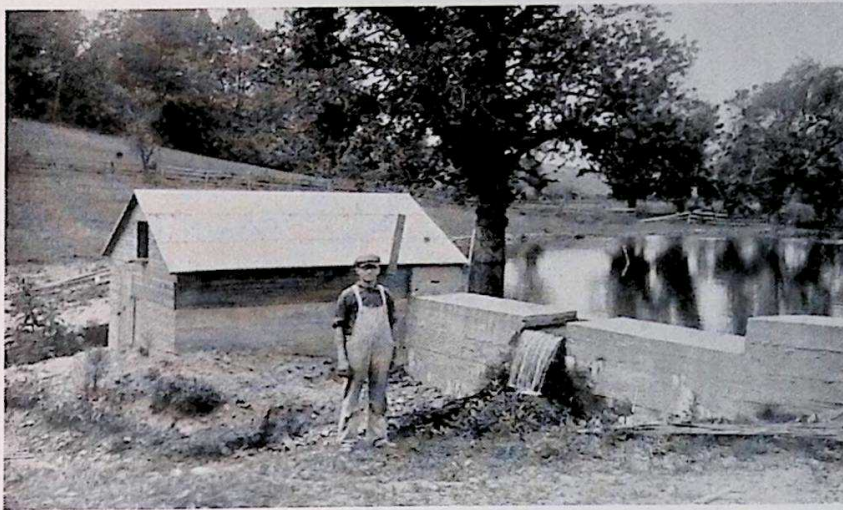


14 ft. Fitz Overshoot on country estate in Delaware. Other members of the same family have installed similar plants both in New Jersey and in Pennsylvania.

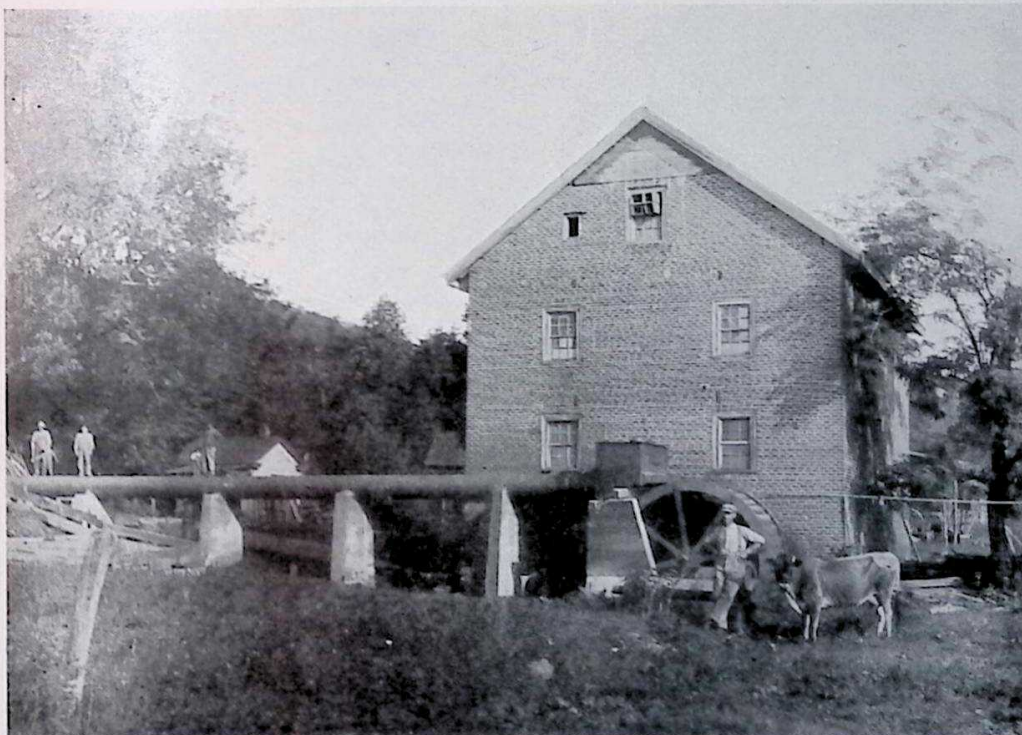
The Fitz Overshoot is the only overshoot that can be automatically governed



Small Fitz Overshoot fed by steel flume from earth fill dam, supplying water to three homes and pumping against a pressure of 258 ft. Plant built for Mr. Charles H. Carson, of Roanoke, Virginia



Even a little stream like this can light a farm house. A 6 ft. diameter Fitz Overshoot in this little building supplies the farm house and large poultry houses of Mr. Paul G. Sellers, Unionville, Penna. Water wheel runs continuously and charges into storage battery



Fitz Overshoot driving flour mill in Virginia. The regulating gate is mounted in our "battle-ship" type steel gate box.

The round steel pipe that carries the water from the dam to the water wheel is laid on a lower level than the top of the water wheel. Consequently the pipe is always full of water and there is no loss of area when the head is drawn down low.

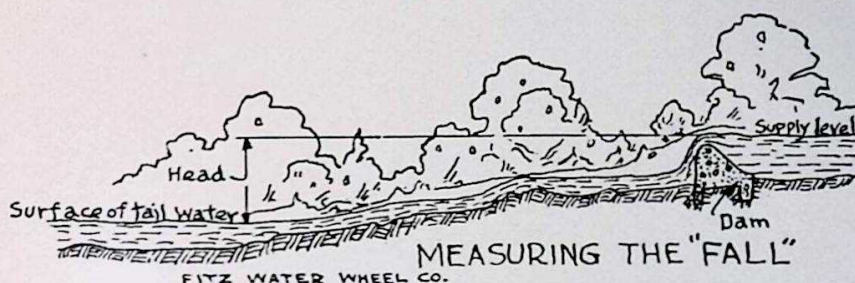


Fitz Water Wheels provide an ideal source of power for Municipal Water Supply Systems. The two pumping stations shown on this page are owned by Mr. J. N. Phelps of Roanoke, Virginia. Each plant is equipped with a Fitz Overshoot, direct geared to a large triplex pump. Together the two plants supply the entire Metropolitan District of Roanoke, surrounding the city on all sides. They pump over two million gallons per day thru 38 miles of pipes. They run 24 hours daily, requiring extremely little attention or upkeep.



How to Develop a Water Power

Water power can be developed wherever a stream of water falls over a ledge or runs swiftly over a series of shoals or rapids. In other words, any flowing stream is capable of producing a certain amount of free power, the amount of this power depending upon the quantity of water which the stream will supply, and the amount of fall or drop which is available. Therefore, in the development of any water power, the first items to be considered are the flow of the stream measured in gallons or cubic feet per minute, and the fall, or vertical drop which can be secured.



Measuring the Fall

By "fall" is meant the operating head, or the distance through which the water will drop in the developing of its power. It is the distance from the upper level, the crest of the dam, if one is used, to the surface of the water in the stream after it has sought its lower level.

If the fall is already concentrated at one point, in a cascade, or by means of a dam, it is a very simple matter to measure the vertical distance from the top of the water at the crest of the cascade, down to the surface of the water at the foot of the fall. Care should be taken to measure to the surface of the water at the foot of the falls, and not to the bed of the stream.

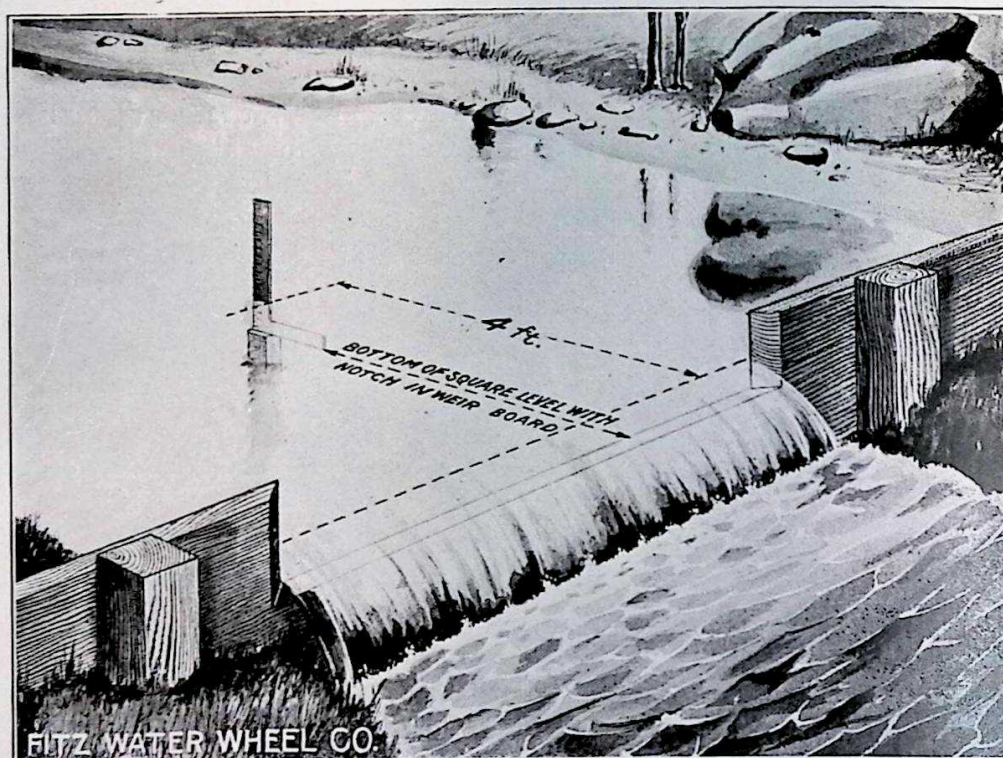
If the fall or "slope" of the stream is distributed over a series of rapids or little falls, it will be necessary to use a leveling instrument to determine the amount of drop. A surveyor, with his transit, is often employed to run these levels, but any man with a fairly good eye can get the approximate measurements by the aid of the ordinary carpenter's level.

Measuring the Water by a Weir Dam

The most accurate way of measuring the flow of a stream is by the Weir Dam method, illustrated on page 58. If the stream is not too large, take a board long enough and wide enough to form a dam across it. Cut a notch in this board, as shown in the illustration, about two thirds the width of the dam, and deep enough to allow the water to pass through. Be careful to have the bottom of the notch exactly level so that the water will be of the same depth all the way across. Bevel the board on the down stream side all around the opening, so that the sharp edge, as shown, will be on the upstream side.

Drive a stake in the bed of the stream about four feet upstream from the dam, so that the top of the stake will be just level with the bottom of the notch. See that the dam is made perfectly tight so that all the water must pass through the notch. Care should be taken to use a board wide enough to dam the water to a dead level before it begins to flow through

the notch. After the water rises to its maximum height over the notch, measure its depth "on the stake" and also measure the width of the notch. By referring to the Weir Table, the flow of the stream can then easily be determined.



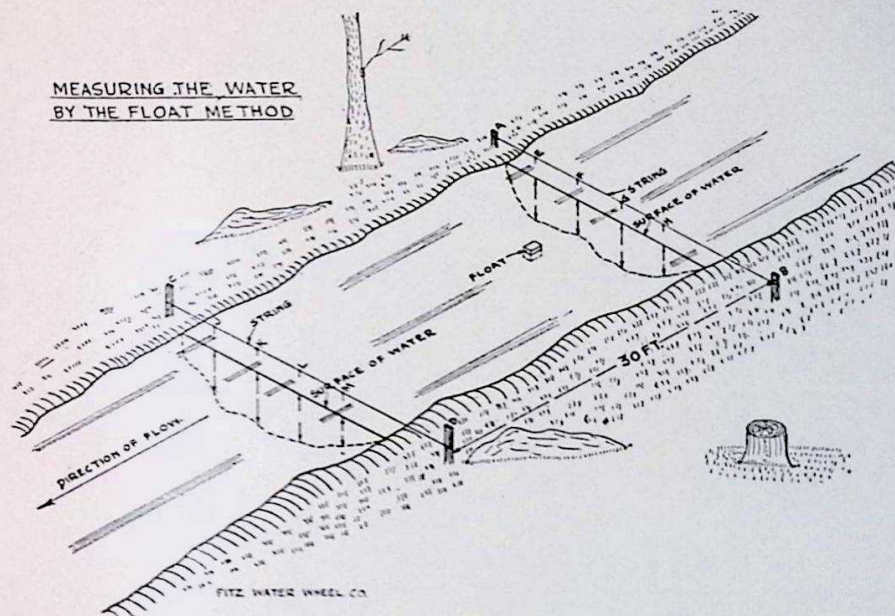
WEIR TABLE

	0	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
0	.00	.01	.05	.09	.14	.19	.26	.32
1	.40	.47	.55	.64	.73	.82	.92	1.02
2	1.13	1.23	1.35	1.46	1.58	1.70	1.82	1.95
3	2.07	2.21	2.34	2.48	2.61	2.76	2.90	3.05
4	3.20	3.35	3.50	3.66	3.81	3.97	4.14	4.30
5	4.47	4.64	4.81	4.98	5.15	5.33	5.51	5.69
6	5.87	6.06	6.25	6.44	6.62	6.82	7.01	7.21
7	7.40	7.60	7.80	8.01	8.21	8.42	8.63	8.83
8	9.05	9.26	9.47	9.69	9.91	10.13	10.35	10.57
9	10.80	11.03	11.25	11.48	11.71	11.94	12.17	12.41
10	12.64	12.88	13.12	13.36	13.60	13.85	14.09	14.34
11	14.59	14.84	15.09	15.34	15.59	15.85	16.11	16.36
12	16.62	16.88	17.15	17.41	17.67	17.94	18.21	18.47

This table is to assist in ascertaining the capacity of a stream of water. It gives the number of cubic feet of water that will pass over a Weir one inch wide, and from $\frac{1}{8}$ of an inch to $12\frac{7}{8}$ in depth. The figures on the first upright column represent whole inches, and those on the top horizontal line represent fractional parts of an inch of depth over the Weir. The figures on the second upright column indicate the number of cubic feet of water that will flow per minute over the Weir, for whole inches in depth, and on the succeeding columns whole inches and the fractions under which they occur. Then the number of cubic feet thus found, multiplied by the width of the Weir in inches, will give the capacity of a stream. EXAMPLE—To find the amount of water that will flow over a Weir, $6\frac{1}{2}$ inches deep by 50 inches in width, follow down the left hand column of figures in the table to 6, then across, until directly under the $\frac{1}{2}$ in the top line, where will be found 6.62; this, multiplied by 50, will give 331, the number of cubic feet per minute that passes over the whole weir.

Easier Method to Measure Stream

An easier method of measuring water is known as the FLOAT METHOD. While not as accurate as the Weir method, it is the most practical and convenient means of measuring the larger streams. Select a place where the bed of the stream is smooth and comparatively uniform both as to width and depth. Throw into the middle of the stream some floating objects of sufficient weight to sink well into the water. Time the passage of these floats between certain fixed points, say twenty to thirty feet apart, to obtain the number of feet per minute which they travel.



Make a half dozen or more tests so that a fair average can be obtained. This will establish the speed or rate of flow of the water. The measurements of the depth and width should be taken at a number of points between those used in determining the velocity, so that average measurements are secured. The product of the average width by the average depth, (expressed in feet,) by the average velocity of the water in feet per minute, will be the flow of the stream in cubic feet per minute.

How to Calculate Amount of Power

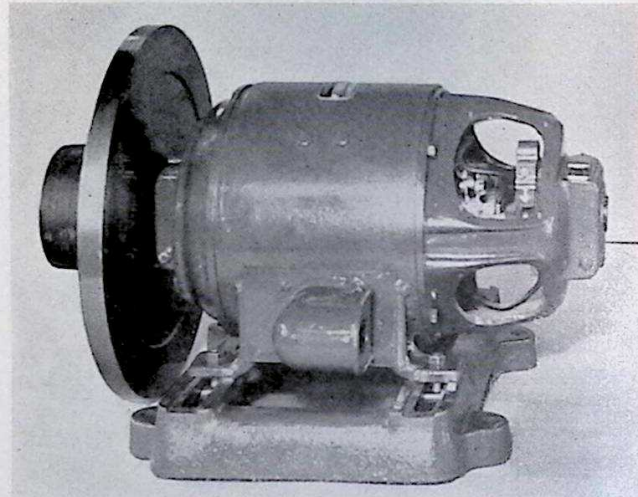
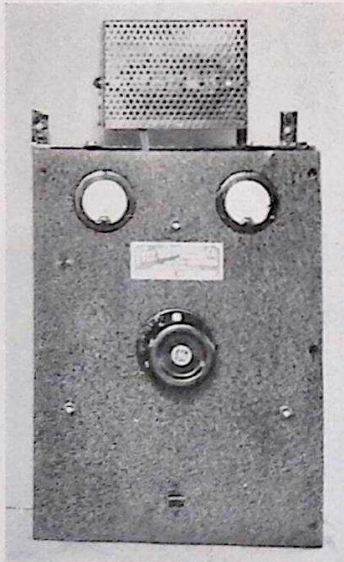
After having measured the flow of the stream, and having determined what amount of fall can be used to advantage, the next step is to calculate the amount of power which can be developed. By a horse power is meant the amount of power required to raise 33,000 pounds one foot per minute. To compute the horse power of any stream, multiply the number of cubic feet of water it flows per minute by 62.4, the weight in pounds of one cubic foot of water. Multiply this product by the amount of fall expressed in feet, and divide the product by 33,000. The result will be the full horse power of the stream.

Special Types of Electric Generators Available with Fitz Water Wheels

Any standard type of generator can be driven by water power, but to obtain the best results the generator should be designed for water power operation.

We furnish either A. C. or D. C. units as desired. For very small plants, D. C. is usually recommended on account of its greater simplicity and superior convenience in driving small motors.

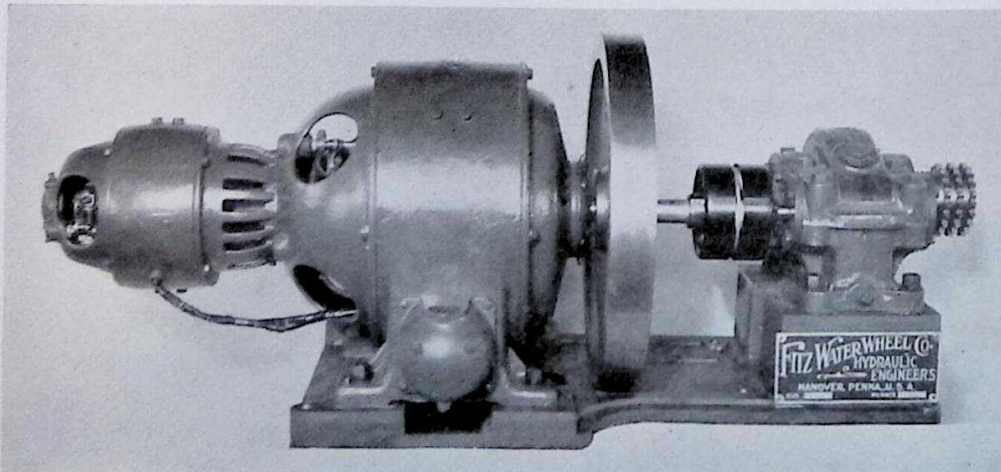
The two types of generators shown below represent only a few of the various types that we supply to meet various conditions.



Self-Regulated D. C. Generator and Switchboard
for 110 volt direct current

These self-regulated, thyrite-controlled D. C. Generators are very convenient for use with ungoverned water wheels. They maintain their voltage within close limits over the entire range of speed of the turbine from no load to full load. Consequently lights or motors can be turned off or on as desired, without having to regulate the speed or power of the wheel.

They furnish 110 volt current D. C. and can be supplied in capacities of from 1 K. W. to 20 K. W. Standard speeds available are 850 RPM or 1150 RPM or 1750 RPM.



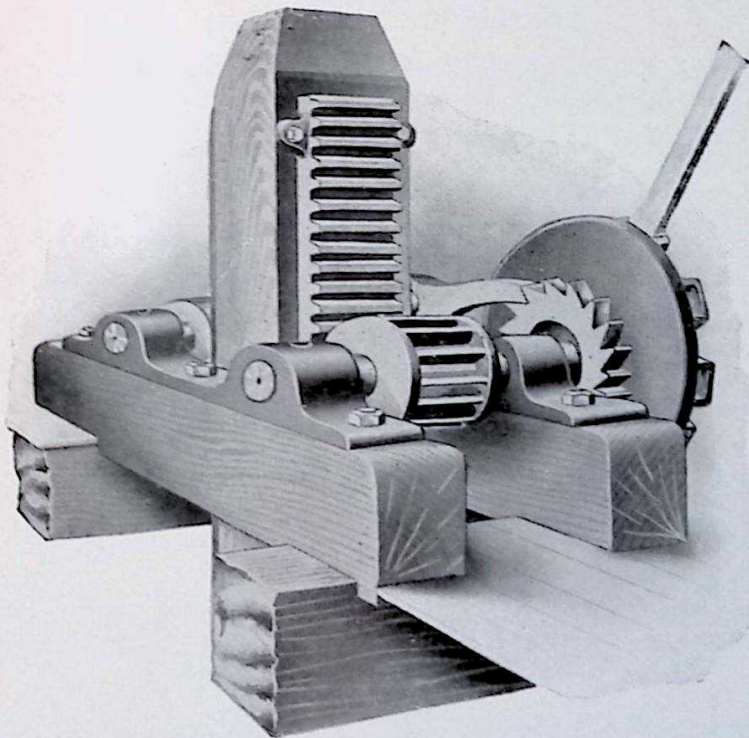
A. C. Generator with direct-connected exciter and direct coupled speed-box requiring an input of only 330 RPM. Available in single phase or 3 phase.
Ball-bearing or sleeve bearings

We also furnish ball or sleeve-bearing single phase A. C. Generators for small plants, equipped with 3 wires, permitting current to be transmitted at 250 volts on long runs, and to be taken off the line at 125 volts wherever desired, without requiring the use of a transformer. A ball-bearing vertical A. C. Generator of this type is illustrated on Page 31.

Both vertical and horizontal Generators can be furnished in 3-phase when wanted. Other Standard Types of 3-phase A. C. Generators are shown on Pages 35, 37 and 40.

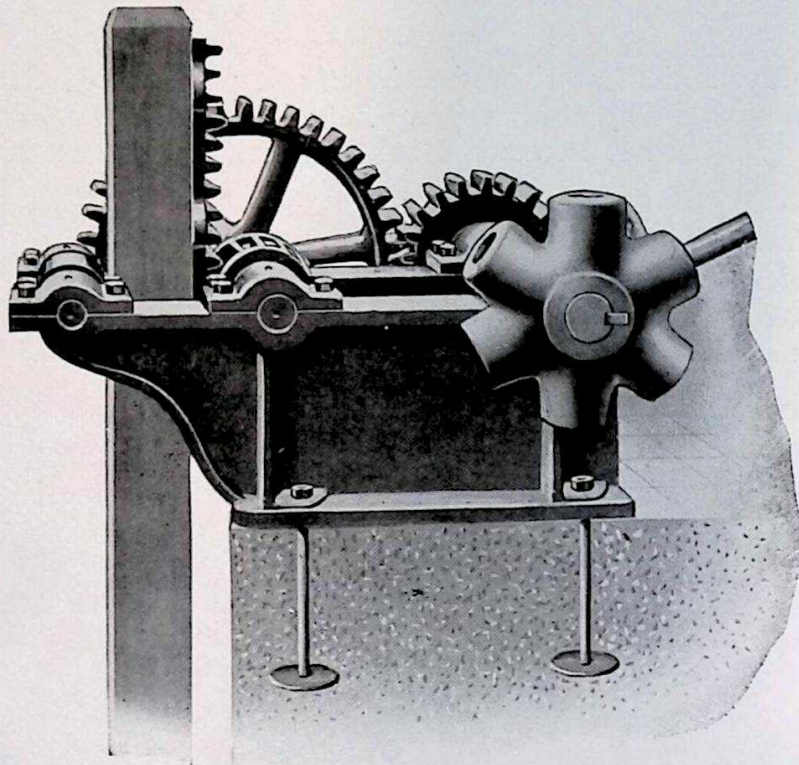
A. C. Generators can not be equipped with self-regulating features. Their speed must be held within close limits at all times when motors are to be driven. Consequently we recommend equipping the water wheel with an automatic governor when A. C. is to be used. Standard A. C. speeds are 900 rev., 1200 rev., and 1800 rev.

Head Gate Hoists



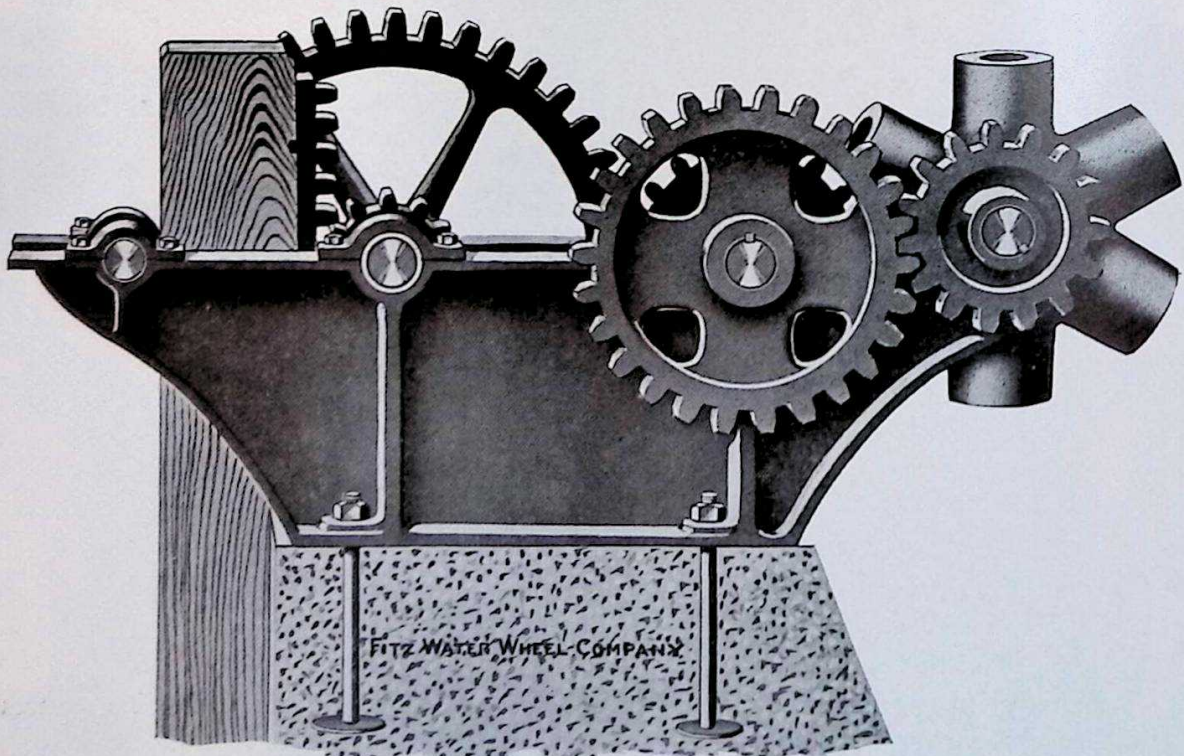
Single Geared Gate Hoist.

A very inexpensive hoist for small head gates. We supply the iron parts and the purchaser furnishes his own wood or concrete mounting.



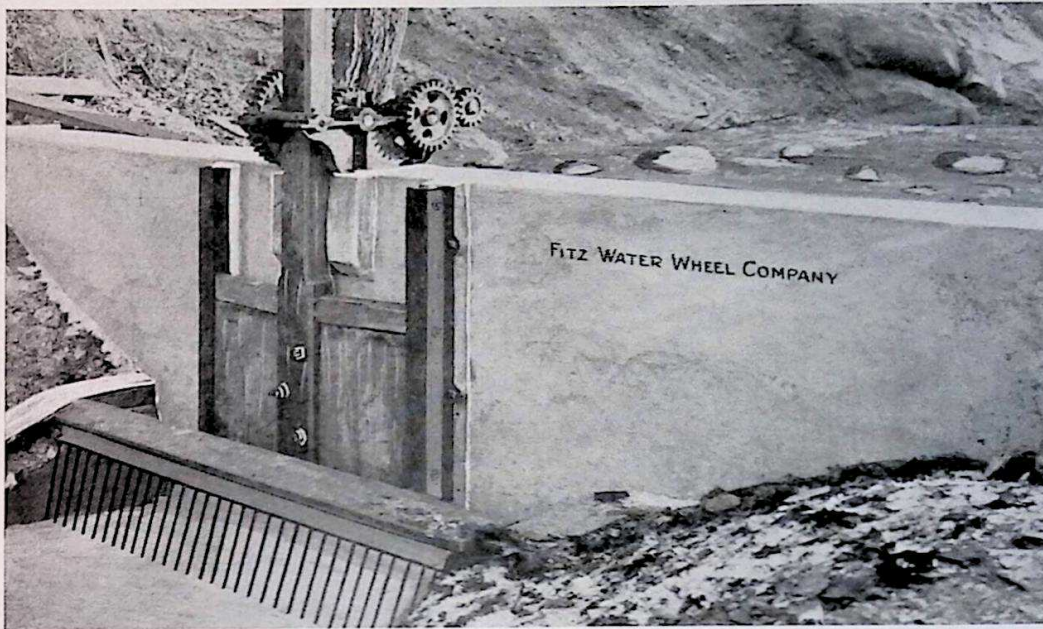
Fitz Double Geared Hoist.

This hoist is suitable for larger and heavier gates than the single geared hoist. It is very powerful and will suit gates of up to 48" x 48" openings, operating against heads of ten feet. With smaller gate openings correspondingly higher pressures can be used.



Fitz Triple Geared Hoist.

This is a still heavier hoist for use in raising flood gates in dams where the pressure is heavy. Besides affording additional leverage, the 3rd set of gears enables a downward push on the lever bar to lift the gate upward. This is the hoist shown with the 60" x 60" gate on Page 63.

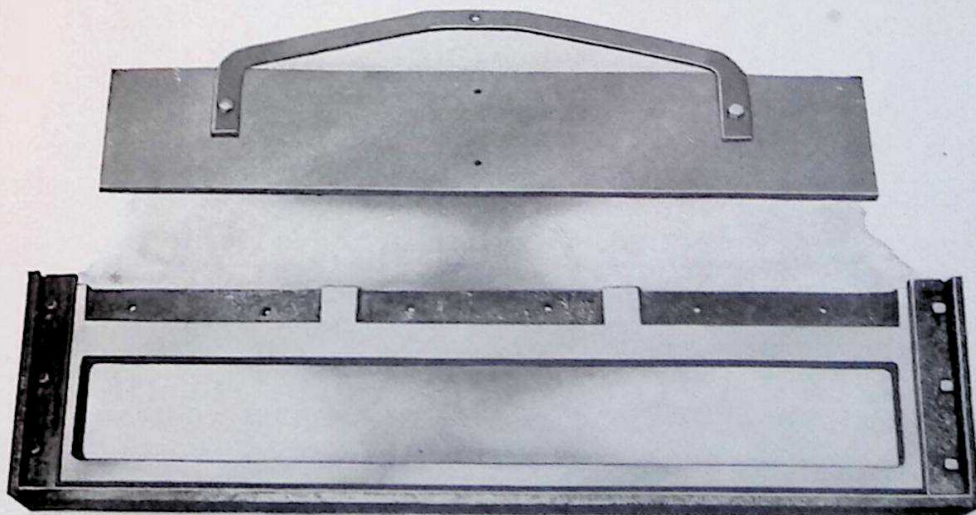


Gate Irons for Heavy Waste Gates

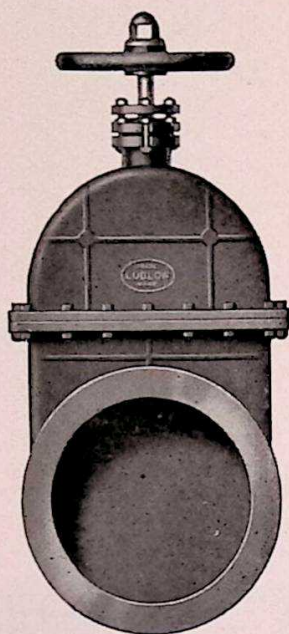
A very economical plan for a large head-gate or for a large waste-gate in a dam of moderate height is shown in the illustration above.

We furnish the iron frame with planed bearing surfaces and the customer supplies the wood sliding piece or "gate leaf." The gate frame bolts to the upstream face of the dam or bulk head. The illustration shows a 60" x 60" gate of this type with a steel trash rack and our triple-gear hoist.

For heavier pressures we can supply all-iron gates with bronze-fitted bearing surfaces, and with either round or rectangular openings.

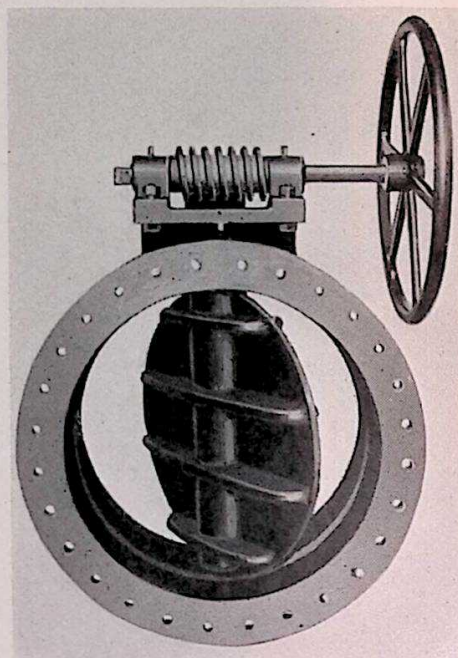


Iron Gate With Cut-off Slab Removed



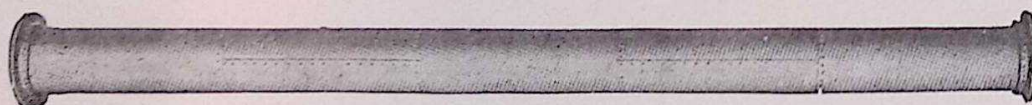
Gate Valves

Every dam should be provided with some means of draining it in order to wash out the mud or silt that will accumulate in time. We can furnish either gate valves or sluice gates for such purposes.



Butterfly Valves

Can be mounted at any convenient point in pipe line, just like a gate valve. Often installed directly back of turbine case in locations where the head gate or inlet to the flume is too far away from the turbine.



Fitz Riveted Steel Pipe.

This pipe is made from copper-bearing steel, a special alloy of copper and steel which has proven to be far more durable than ordinary steel plates.

Our pipe is usually shipped in lengths of about 20 ft. but any shorter or longer lengths can be supplied. Rivets to connect sections of pipe together in the field are supplied without charge. Steel flanges and bolts can be furnished at additional cost, if preferred.

Other Fitz Products

Automatic Water Wheel Governors; Power Transmission Equipment; Trash Racks; Spur Gears and Bevel Gears; Wood Cogs for mortise gears, etc.

